3. PORTS AND TERMINALS

3.1 IDENTIFICATION OF OPERATIONS AND ACTIVITIES

3.1.1 Introduction

The safe operation of ports and terminals depends on a broad range of critical operations and activities that are undertaken on a regular basis. The execution of these critical operations and activities can create hazards that, if not properly addressed, can have disastrous consequences. The risks associated with these hazards must be carefully evaluated to establish cost-effective and efficient prevention and mitigation measures. The goal of these prevention and mitigation measures must be to reduce risks to an acceptable level.

A standard risk register for ports and terminals was developed following consultation and site visits with National Working Groups in the MRC Member Countries. The ports and terminal risk register was standardised intentionally as the overall objective is to develop at a harmonised system for the storage and handling and of dangerous goods in port areas and terminals along the Mekong River. The risk analysis will determine the baseline conditions in each of the Member Countries to evaluate the level of risks, existing control measures and the future priorities.

3.1.2 Ports and Terminals Hazard Groups

The preparatory step in drafting the risk register was to identify and describe all the major operations and activities associated with the storage and handling of dangerous goods in ports areas and the storage and handling of petroleum and hazardous substances in terminals. The risk register is a comprehensive assessment tool, enabling a more structural analysis. The critical activities and operations were combined into the following hazard groups:

1. infrastructure and superstructure
2. mechanical equipment

3. electricity
4. operations
5. maintenance
6. human elements
7. management and regulations
8. global events
9. additional

These nine hazard groups have subsequently been analysed and divided into key components which are criticals. The failure of any of these key components has the potential to increase risks to the environment, safety of personnel, members of the public, property or stakeholders. The main concept in establishing the risk register was to determine what items present in a port area or a petroleum/chemical terminal can influence environment, safety, property or risks to stakeholders. Several terminal layouts and port areas were taken into consideration.

Each component was analysed and all connected activities and operations were identified and evaluated. Key components may be connected to several activities and operations. For example, a cargo pump is a critical component in terminal and port areas. Possible activities and operations connected are loading and discharging operations and also maintenance to ensure safe and continuous operation of the cargo pump. This was taken into account in the risk registers. The main activities/operations are defined as follows:

- **All** can be applied to several activities and operations. For example, correct Personal Protective Equipment (PPE) must be worn for all tasks, not only activities relating to the loading/discharging of dangerous goods;
- **Loading/discharging** (cargo operations) is transfer of dangerous goods to and from a port area/terminal;
- **Maintenance** is fixing, repairing or servicing of all equipment;
- **Management** is all actions that relate to planning, resourcing, monitoring and controlling operations;
- **Design** is a plan or a convention for the construction of an object or system;
- **Incident** is an occurrence that can lead to severe consequences;
- **Emergency** is a sudden, urgent, usually unexpected occurrence that requires immediate action;
- **Spill** occurs when the contents of something, usually in liquid form, spills onto a surface;
- **Storage** relates to storage tanks and designated storage in port areas and terminals;
- **Safety and quality management** is a systematic way of ensuring operations and activities are carried out as planned. Maintaining safety and quality management is a discipline concerned with preventing problems from occurring by creating attitudes and controls that make prevention possible.
- **Inspection** is a systemised approach involving measurement and testing in regard to an object or activity. The results are usually compared to specific requirements and standards for determining whether the item or activity is within these parameters.

- **Authorities and Regulations** includes legislation, regulations, compliance with legislation, monitoring implementation and inspection by authorities; and
- **Terminal or port management systems** are an overall plan, principles and guidelines for the safe operation of the port and terminal.

3.1.2.1 Infrastructure and Superstructure

The infrastructure hazard group contains all the fundamental facilities and systems of a port area or petroleum/chemical terminal. These are the core items of every port or terminal. The following items were included in the risk register for assessment:

- proximity to populated areas;
- access to port facilities;
- tank structure;
- cargo pumps;
- cargo pipes and hoses;
- valves;
- warehouses, sheds and other storage areas;
- cranes;
- waste reception facilities (all kinds of vessel waste);
- fixed firefighting equipment (pipes/pumps);
- portable firefighting equipment;
- fire detection equipment;
- gas detection equipment;
- personal protective equipment, safety equipment, first aid; and
- emergency equipment.

3.1.2.2 Mechanical Equipment

This hazard group contains all mechanical equipment used at petroleum terminals to perform and monitor cargo operations. For the port areas, all mechanical equipment used specifically for the transfer of dangerous goods was taken into consideration. The following items were included in the risk register for assessment:

- tank measurement instruments and capacity alarms;
- tank wagons;
- tank trucks;
- communication means;
- ordinary trucks and trailers;
- forklift trucks and reach stackers; and
- generators.

3.1.2.3 Electricity

This hazard group contains all electrical equipment, electrical installations and other electrical related equipment present in port areas and terminals. The following components were assessed in the risk register:

- high-voltage installations;
- all related cables and cabling;
- electrical equipment; and
- circuit breakers.

3.1.2.4 Operations

This hazard group contains all items concerning the transfer and storage of liquid bulk, dry bulk and packaged dangerous goods. The following components were assessed in the risk register:

- receiving/delivering of liquid bulk;
- storage of liquid bulk;
- receiving/delivering of dry bulk;
- storage of dry bulk;
- receiving/delivering of packaged dangerous goods;
- storage and segregation of packaged dangerous goods; and
- monitoring and control of stored cargo.

3.1.2.5 Maintenance

This hazard group contains all items related to fixing, repairing and overhauling devices. The following components were assessed in the risk register:

- maintenance of equipment; and
- hot work.

Hot work was important to include in the risk register as it is any process that can be a source of ignition when flammable material is present or can be a fire hazard regardless of the presence of flammable material.

3.1.2.6 Human Elements

This hazard group contains all items that can have influence or affect the capacity of a person to perform a certain operation. The following components were assessed in the risk register:

- working hours;
- education;
- experience;
- training; and
- communication and information.

3.1.2.7 Management and Regulations

This hazard group consists of items related to the management of ports and terminals and the compliance with existing regulations, technical requirements and terminal and port operating policy and procedures in use. The following components were assessed in the risk register:

- safety, quality and environmental management systems;
- inspection of port/terminal;
- terminal policy and procedures;
- security;
- emergency response plans and procedures;
- training;
- waste management
- drugs and alcohol; and
- authority control.

3.1.2.8 Global Events

This hazard group contains natural disasters and external events that can influence the safe operation of the port and terminal. Global events such as flooding, lightning, mud slides, heavy and prolonged rain storms, typhoons, high winds, tsunami or tidal wave and earthquakes were assessed in the risk register.

3.1.2.9 Additional

As the risk register is dynamic this section was created in the event that additional hazards were determined during the course of the risk assessment at the terminal and port areas related to the storage and handling of dangerous goods. National Working Groups were encouraged to use this section to determine critical activities/operations and the associated hazards and risks.

3.2 IDENTIFICATION OF HAZARDS AND POSSIBLE CONSEQUENCES

3.2.1 Introduction

Ports and terminals are viewed as the core of national and regional development. They generate important economic benefits and create jobs. They are organisationally, physically, legally and environmentally complex, with many stakeholders, many facilities and different organisations. The safety of port and terminal facilities, port workers and the surrounding communities, and the protection of the environment have become important issues that need to be addressed.

3.2.2 Ports and Terminals Hazard Groups

In the preparatory, step nine hazard groups were identified to facilitate the investigators to fill in risk registers when they made their assessments. These groups have subsequently been analysed and divided into key components. For each of the key components, all possible hazards were identified.

3.2.2.1 Infrastructure and Superstructure

1. Proximity to Populated Areas

The main hazards for ports or terminals handling dangerous goods located close to densely-populated areas are increased numbers of lives lost, persons injured or property damaged if an emergency arises. Emergency response plans must take into account the possibility that local communities will need to be evacuated, extra manpower necessary and more difficult access to the premises for emergency services. Increased frequency of trucks carrying dangerous goods on and off the premises increases the risk of those trucks getting involved in a road accident.

2. Access to Port Facilities

How easy is it for persons outside the port or terminal to gain access to areas where dangerous goods are stored? Does the port or terminal have surrounding fences, is there a security guard at the entrance, is the terminal equipped with closed-circuit television (CCTV) and does it comply with the International Ship and Port Security (ISPS) Code? The main hazard investigated in the risk register is the possibility of having uncontrolled access to port and terminal facilities. Uncontrolled access means there is a risk that members of the public could damage equipment, steal liquid bulk products, damage packaged dangerous goods or cause fires or explosions either deliberately or unintentionally.

3. Tank Structure

The risk register investigated all receptacles for the storage of liquids and gases at ports and terminals. The main hazards relating to the condition and structure of the tanks were considered. A tank collapsing or leaking can result in the spillage of flammable liquids and release explosive or toxic vapours. Figure 9 provides an example of the structure of an internal floating roof tank.

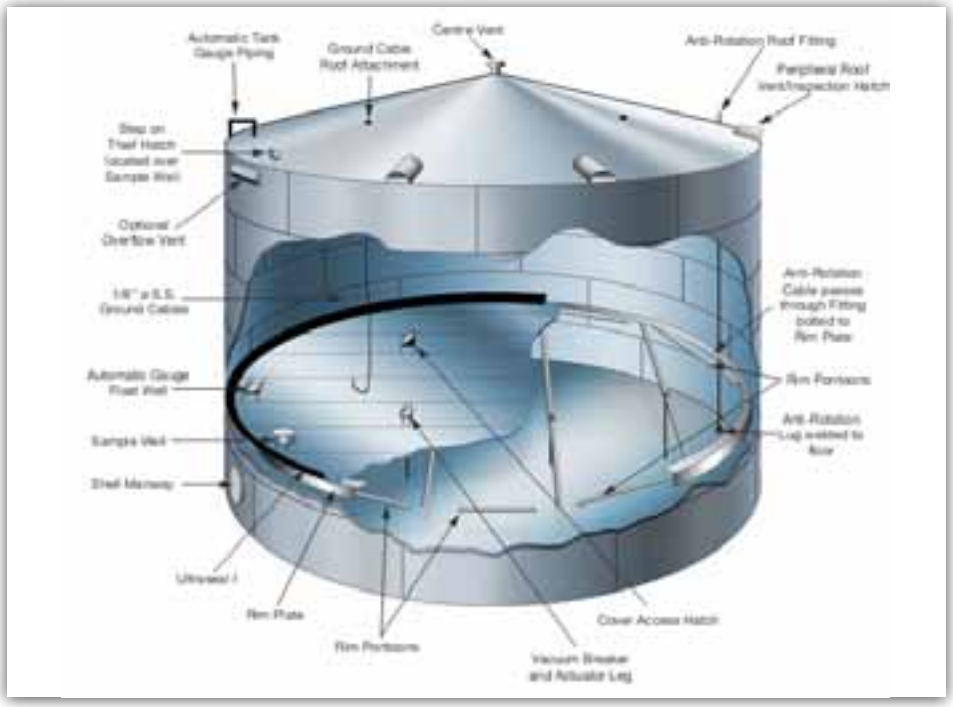

Figure 9: **Internal Floating Roof Tank**[1]

[1] http://www.landandmarine.com/TankServProducts/InternalFloatingRoof.aspx

4. Cargo Pumps

Cargo pumps (Figure 10) together with cargo pipes and hoses are the core of petroleum terminals. As cargo pumps are used on a daily basis, they should be regularly inspected and well maintained. Inspection and maintenance records should be kept and procedures developed for safe operations. The main hazards investigated were to determine what systems are in place to prevent pump failure, ensure pumps are not blocked or leaking and that there is a regular inspection of equipment. There are a number of risks associated with cargo pumps including the release of liquid toxic gas, inflammable or explosive vapours, fire, explosion, property damage, commercial loss, safety and pollution.

Figure 10: **Cargo Pumps**[2]

5. Cargo Pipes and Hoses

Cargo transfer hoses (Figure 11) and pipes (Figure 12) are often the cause of cargo spillage. They should be visually inspected for deterioration and damage at regular intervals. At least annually, they should be hydrostatically pressure tested to 1.5 times the maximum allowable working pressure (MAWP) to check for leakages or movement of end fittings. Records of these inspections should be kept during the service of the hose. Hoses in bad condition or deficient hoses should be immediately withdrawn from service. The main hazards associated with the use of cargo hoses and pipes include leaking, not being properly rigged and specifications not being followed.

Figure 11: **Cargo Transfer Hoses**[3]

Figure 12: **Cargo Pipes**

[2] http://www.bornemann.com/wanted/our-expertise-for-tank-storage-and--terminals-and-refineries/tank-terminals/the-netherlands---type-hc-370

[3] http://www.hellotrade.com/techflow-marine/cargo-offloading-and-loading-hose-system.html

Additional hazards could derive from:

- **no regular inspection**;
- **piping subject to surge pressure.** This is a sudden increase of pressure due to a change in fluid velocity caused by an unplanned pump trip or rapid valve operation. Surge pressure can cause rupture of the cargo hose which can lead to an extensive spill;
- **maximum allowable working pressure (MAWP) being exceeded.** MAWP is used as a reference by the United States Coast Guard. Other commonly-used terms are rated working pressure (RWP) and maximum working pressure (MWP);
- **gaskets leaking**; and
- **safety devices not working properly.** These could be pressure relief valves[4], emergency stop systems and powered emergency release couplings (PERC)[5] (Figure 13 and 14).

Figure 13: **Powered Emergency Release Coupling[6]**

Figure 14: **Pressure Relief Valve (painted blue)**

Cargo lines that are not in use during cargo transfer or all cargo lines when transfer is completed need to be covered with a blind flange and all matching bolts in position and well tightened. Cargo line not correctly blinded increase the risk of spillage in case of line up mistake. Figure 15 shows a cargo line that has not been blinded (this picture was made during one of the site assessment) and Figure 16 illustrates a correctly blinded cargo line.

[4] Pressure relief valve is a type of valve used to control or limit the pressure in a system or vessel which can build up by a process upset, instrument or equipment failure, or fire.

[5] Powered emergency release coupling (PERC) is a device that enables a rapid disconnection of marine loading arms from the vessel in case of an emergency such as fire onboard or excessive drift.

[6] http://www.fmctechnologies.com/LoadingSystems/Technologies/Accessories/EmergencyReleaseSystems-ERS.aspx

Figure 15: **Cargo Line Not Blinded**

Figure 16: **Correctly Blinded Cargo Line**

Other risks can be derived from:

- **no colour coding used.** Colour coding of cargo pipes is commonly used to make it easy for the operator to identify the correct line and to avoid mistakes;
- **insufficient pipe welding**;
- **piping located in areas with dense vehicle traffic.** If not properly protected, these are vulnerable to damage caused by impacts of vehicles which could lead to an extensive spill;
- **steam pipes not properly insulated.** This can cause injuries to personnel as it is visually not always clear if steam is running through the pipes;
- **no regular pressure test performed.** A hydrostatic pressure test should be performed at regular intervals to check the integrity of the pipes and hoses. A pressure test should also be performed in case the rated pressure of the hose has been exceeded;
- **no flame arrestors on vent lines.** Flame arrestors serve as a safety device and should be periodically inspected to make sure that they are free of dirt, corrosion or damage;
- **corrosion rates not regularly inspected.** This can cause reduction in the wall thickness of pipes, either external or internal. External corrosion can be caused by a contact point at a pipe support. Internal corrosion can be caused by the flow of liquid. The reduction of the wall thickness can eventually lead to a crack in the pipeline (Figure 17) or corrosion at the contact pipe of a pipe support (Figure 18).

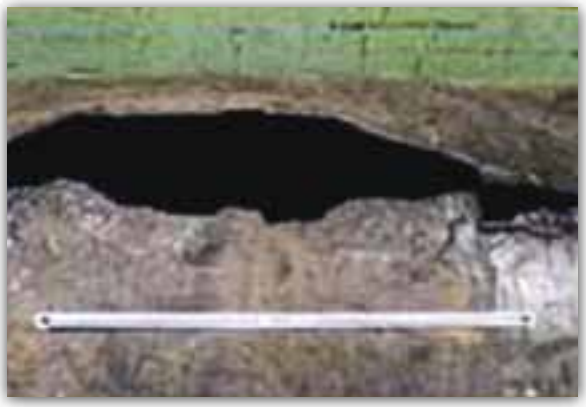

Figure 17: **Corrosion Failure of Pipeline**

Figure 18: **Corrosion at a Contact Point at a Pipe Support**[7]

There are a number of hazards associated with cargo pipes and hoses as they are critical components of a terminal. Replacing a deficient hose during cargo transfer means commercial loss as the cargo operations need to be interrupted, cargo needs to be removed from the hose, the hose needs to be disconnected and a new section needs to connected. Rupture or leaking of a cargo hose can lead to an extensive spill with high cleanup costs or the release of liquid inflammable, toxic or explosive vapours which can have disastrous consequences such as fire or explosion.

6. Cargo Valves

Cargo valves are also critical components of terminals and port areas for discharging and loading cargo. Terminals have mainly two types of valves. These are manually-operated valves (Figure 19) and remotely-operated valves (pneumatic or hydraulic) (Figure 20). Manually-operated valves need the local attendance of an operator to open or close the valve. Remotely-operated valves are opened or closed from a location different from the valve. The main hazards associated with these types of valves are that they are blocked, leaking or fail to operate.

Figure 19: **Manually-Operated Valves**

Figure 20: **Remotely-Operated Valves**

[7] http://www.ammonite-corrosion.com/prot_coat.html

Other possible hazards can be derived from the following:

- **valves not properly labelled**. Valves can be labelled using numbers or letters;
- **indicator light not working.** Remotely-operated valves are provided with indicator lights so the operator can visually check if certain valves are open or closed;
- **emergency valves not readily accessible.** Emergency valves should be readily accessible; and
- **valves added to original system design.** Valves added to the original plant layout, mostly done with good intentions, can have disastrous consequences.[8]

The possible consequences of leaking valves include spillage, the release of flammable, toxic or explosive vapours and the interruption of cargo operations. Valves that are blocked or fail to operate can cause a reasonable increase of the pressure in cargo transfer pipes or hoses. In the event of emergency valves not being accessible this can lead to delayed emergency response.

7. Warehouse, Sheds and Other Storage Areas

Warehouse, sheds and other storage areas are commonly used for temporary storage of goods. If used to store dangerous goods, however, they need to meet certain requirements which depend on the kind of goods stored. Sheds are often used to store small amounts of dangerous goods. There are different kinds of sheds such as flammable liquid storage sheds (Figure 21), chemical sheds and waste oil sheds. Warehouses are usually used to store larger amounts of dangerous goods (Figure 22).

Figure 21: **Flammable Liquids Storage Shed**[9]

Figure 22: **Dangerous Goods Warehouse**

The main hazards involved with the storage of dangerous goods are that there is no proper segregation of the dangerous goods, the area or surface is not suitable for the storage of dangerous goods or the storage area itself is not suited for the storage of dangerous goods. The possible consequences are chemical reaction with other dangerous goods which can lead to fire, explosion or release of toxic vapours. Another hazard is that there is no or limited firefighting equipment available to respond to fires.

[8] Chemical Process Safety – Learning from case histories, Roy E. Sanders

[9] http://www.shadesheds.com/flammable-liquid-storage.html

8. Cranes

This includes all lifting machinery used on the terminal premises to handle cargo transfer equipment such as cargo hoses and gangways and lifting machinery used in port areas to transfer dangerous goods to and from vessels (Figure 23). The main hazards associated with the operation of cranes in port areas and terminals include:

- **safe working load (SWL) being exceeded.** SWL indicates the load a crane can safely lift, suspend or lower and should be clearly marked on the crane;
- **lifting slings not being the approved type or used beyond their capacity**;
- **cranes not inspected or tested at regular intervals**; and
- **safety and warning devices not working properly**. If during loading and discharging the crane, slings or equipment fails, packaged dangerous goods could fall, leading to the release of toxic gases, flammable vapours, pollution and commercial losses. Cranes failing can also cause fatalities and severe injuries for personnel and damage to property and equipment.

9. Waste Reception Facilities

The National Working Groups used the risk register to determine whether ports and terminals have adequate waste reception facilities available to handle waste from vessels as well as port and terminal operations. The consequences of not having adequate facilities are that dangerous cargo residues and both solid and liquid wastes are disposed into the Mekong River. The protection of the environment can be enhanced significantly by reducing discharges of all kinds of vessel-generated waste and cargo residues into the river. The development of adequate port reception facilities (PRF) for waste and cargo residues from vessels, together with the establishment of systems which provide incentives for vessels to use these facilities, are major elements in the process to reduce discharges by vessels into the Mekong River.

10. Firefighting Equipment

Ports and terminals are required to have a wide range of both fixed and portable firefighting systems. Fire pumps, hydrants, hoses and portable fire extinguishers should be available and regularly inspected and tested. The risk registers determined the type of firefighting equipment available at the ports and terminals

Figure 23: **Typical Port Crane**[10]

[10] http://vme.vn/Products/San_pham_01/1.aspx

to ensure and that they are readily available to respond in an emergency situation. The hazards are that the firefighting equipment is not working properly, fire hydrants are blocked, the pump capacity is not sufficient or there is no shore connection[11] available. If there is a delayed response to fire or the firefighting equipment is not provided or not sufficient, the ports and terminals cannot respond effectively. If their extent is not limited, fires may become uncontrollable which could present severe consequences to property, environment and local communities.

11. Fire Detection Equipment

Fire detection equipment (Figure 24) is key to maintaining the overall safety and operation of a terminal. Fire detection equipment continuously monitors for fire within the terminal and provides early warning to prevent escalation of an incident, protects the terminal, safety of employees and the environment. The risk register checked if the ports and terminals have adequate fire detection equipment, if the equipment is tested at regular intervals and if records of these test are kept. Fire detection equipment not working properly or not regularly tested could lead to a delayed response to fire.

Figure 24: **Typical Fire Detection Equipment**[12]

12. Gas Detection Equipment

Gas detectors continuously monitor for abnormal situations such as the presence of combustible or toxic gas within the terminal premises, provide early warning to prevent the escalation of an incident and protect the terminal, human life and the environment. The risk register checked if the ports and terminals have gas detection equipment and that records of inspection and testing were maintained. If equipment is not available, not calibrated or not tested properly, detection of toxic vapours and gases may be delayed or not occur, leading to asphyxiation, serious injuries or fatalities.

13. Personal Protective Equipment (PPE) and Safety and First Aid Equipment

PPE refers to all clothing, helmets, gloves, eye protection and other equipment designed to protect personnel from injury, blunt impacts, electrical hazards, heat and chemicals. The primary purpose of PPE is to reduce personnel exposure to hazards and reduce the severity of injury in case of an incident. The risk register assessed whether PPE was provided, maintained and available to all personnel at the ports and terminals. The National Working Groups also checked that there were first aid equipment and safety showers, used when personnel are exposed to hazardous substances to reduce the severity of injury. If personnel are not wearing PPE or there is no adequate first aid equipment available or safety showers are not working, there is increased risk of serious injury or fatality in case of an incident.

[11] An international shore connection is a Universal hose connection that enables to connect the vessel's fire main to the shore in case the fire pump onboard fails.

[12] http://www.saltwaterpr.com/Story/Story.aspx?story=4936

14. Emergency Equipment

Emergency equipment is specially-designated material used to deal with emergencies. The goal of this equipment is to reduce the impact of an emergency on the environment, local communities and damage to property. Emergency equipment for ports and terminals includes but is limited to oil spill containment booms, absorbent pads, emergency transfer pumps, fire axes, emergency communication equipment and emergency lighting. The most common emergencies that occur at terminal or port areas are fire, explosion, release of toxic gases, explosive vapours, chemical and oil spills.

No or not enough emergency equipment can lead to delayed response or response failure, increasing the impact of the emergency. An emergency control centre is required to coordinate emergencies with fire, police, authorities and local communities in the event of a major incident. The absence of an emergency control centre can increase risks to local communities, environment and property due to ineffective emergency response.

3.2.2.2 Mechanical Equipment

This hazard group contains all mechanical equipment used at petroleum terminals to perform and monitor cargo operations. For the port areas, all mechanical equipment used specifically for the transfer of dangerous goods was taken into consideration. The following items were included in the risk register for assessment.

1. Tank-Measurement Instruments and Capacity Alarms

Tank-measurement equipment and capacity alarms are used to determine the filling level of a cargo tank (Figure 25). Every cargo tank has a zero level and a predetermined maximum filling level. Filling above this level can cause overflow. During loading, liquid is added to the tank and this results in a rise of the liquid level. This increase is measured against the zero level of the tank. If the maximum filling level of the cargo tank is 10 metres, for example, an operator will know that he can still add a quantity of cargo equal to 6 metres of tank height if the measurement instrument indicates that the current level in the tank is 4 metres . Knowing to what level the tank is filled is important for the operator so he can determine how much cargo can still be safely added without overfilling the cargo tank. Capacity alarms provide operators with an audible and visual indication that the cargo tank has reached the maximum level of filling.

The risk registers determined whether the terminals had tank measurement instruments, capacity alarms and systems to ensure maintenance, calibration and records were well maintained. If tank measurements instruments and capacity alarms are out of order or not functioning properly, the operator is unable to determine how much cargo he can safely add if the tank is already filled till the maximum level. Filling a cargo tank above the maximum level can result in spillage and release of flammable and toxic vapours.

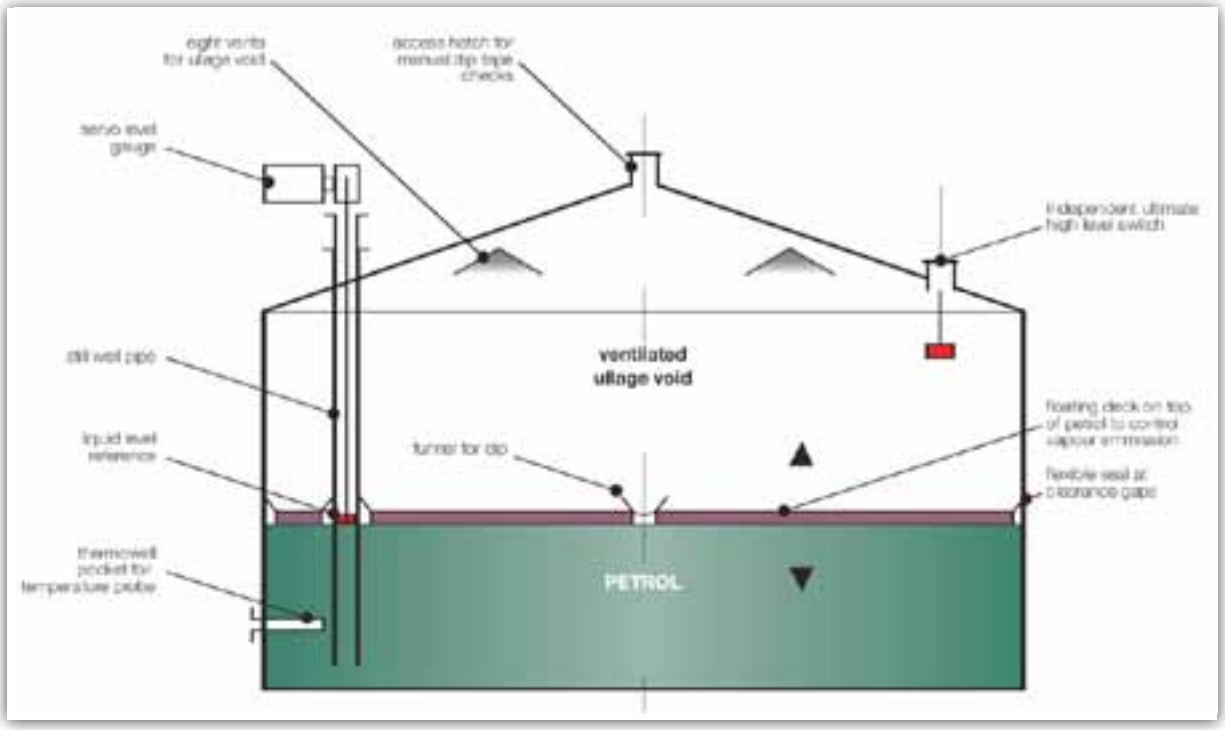

Figure 25: **Tank-Measurements Instruments and Capacity Alarms**[13]

2. Tank Wagons

Tank wagons (Figure 26) are railway wagons carrying a tank for the transport of liquid bulk. The main hazards for tank wagons are leaking valves and tank rupture. The rupture can be caused by impact of an external load. This can result in pollution and the release of flammable liquids and explosive vapours, increasing the risks of fire and explosions.

Figure 26: **Tank Wagons**[14]

[13] Recommedations on the design and operation of fuel storage sites, Buncefield major investigation board, p. 11

[14] www.railway-parts.com/wagons.html

3. Tank Trucks

A tank truck is a motor vehicle designed to carry liquids in bulk (Figure 27). They are used for the transport of a wide variety of liquid dangerous goods. Large tank trucks are, for example, used to transport gasoline to filling stations.

The main hazards of tank trucks are leaking valves or tank rupture, resulting in pollution and the release of flammable liquids and explosive vapours, increasing the risks of fire and explosions.

Figure 27: **Tank truck**

4. Communication

Communication is essential for conveying meaningful information. Conveying information at terminal or port areas is commonly done by means of handheld transceivers (walkie-talkies) or telephones of the approved type. Good communication is a critical component of maintaining safe and efficient operations at ports and terminals. Communication is required between control rooms and port personnel as well as ports/terminals to vessels and trucks. The risk registers determined the type of communication equipment available and whether the communications equipment is explosion proof. An absence of adequate means of communication at ports and terminals can lead to operational errors which can delay operation or lead to incidents. If not explosion proof, communications equipment may ignite flammable vapours during loading and discharging operations.

5. Ordinary Trucks and Trailers

Trucks and trailers are motor vehicles designed to transport cargo (Figure 28). They are commonly used to transfer cargo to and from the port or terminal premises.

The main hazards with ordinary trucks and trailers entering ports and terminals is packages falling due to improper securing of cargo. Damage to packaged dangerous goods can increase the risk of spillage, releasing toxic or flammable vapours, solids or liquid substances. Collisions of cargo with surfaces in port areas and terminals may also ignite flammable materials. Trucks can also pose hazards if there are no site safety rules such as speed limits and barriers to prevent collisions with critical equipment and personnel.

Figure 28: **Trucks and Trailers**

6. Forklifts and Reach Stackers

Forklifts are powered industrial trucks used to lift and transport materials (Figure 29). Reach stackers are commonly used in ports to quickly transport containers over a short distance and they are able to pile containers in rows (Figure 30).

Figure 29: **Forklift**[15]

Figure 30: **Reach Stackers**[16]

[15] http://www.theforkliftcertification.net/tcm-forklift-a-boon-for-the-industry.html

[16] http://www.ncports.com/gallery_detail.htm?i=98

7. Generators

Generators are mostly used as backup power sources. They can, for example, provide uninterrupted power to refrigerated containers. Emergency generators are also used to provide the port or terminal with electricity in case the main electricity sources fail in the case of fire, for example. Emergency generators can provide power to fire pumps and provide emergency lighting.

The risk register determined whether an emergency generator was installed at the ports and terminals with a system for maintenance and inspection developed. The failing or malfunctioning of a generator during operations increases the risk of delays and commercial losses. If it is overloaded or not maintained properly, a generator create sparks and ignition sources for explosive vapours.

3.2.2.3 Electricity

1. High-Voltage Cables

Electric cables are used in ports and terminals to provide electricity to all critical electrical equipment required for cargo handling; cargo pumps, lighting and fire pumps. High voltage cables are also used in ports to provide vessels with high voltage electric power delivered by cable from onshore during their time in port and terminal.

The main hazards relate firstly to the condition and whether the electrical cables are insulated and fire proof and whether there is any mechanical damage evident, inspection and testing procedures are critical at ports and terminals. Secondly, the proximity to high risk areas during loading and discharging operations needs to be considered. Electricity has the potential to cause electrocution; serious injury and fatalities to personnel and sparks are an ignition source for explosive vapours.

2. Electrical Equipment

Electrical equipment is essential for personnel to complete tasks and activities at ports and terminals. The risk register determined whether electrical equipment was explosion-proof, properly earthed and had a system for maintenance and inspection developed. Safe operating procedures and working environment was also considering for personnel operating electrical equipment. The possible consequence of electrical equipment malfunctioning can create ignition sources through overheating. Inappropriate use of electrical equipment can lead to operation errors and possibly electrocution, creating ignition sources that could cause fires or explosions.

Figure 31: **Circuit Breaker**

3. Circuit Breakers

Circuit breakers are automatic switches that stop the flow of electric current in a suddenly overloaded or abnormally-stressed electric circuit (Figure 31). In ports and terminals, circuit breakers are used to protect electric circuits necessary for cargo handling operations.

If circuit breakers are not working or the capacity of the breakers is insufficient for circuit protection, an overloaded circuit could overheat and become a possible source of ignition for fires and explosions.

3.2.2.4 Operations

The loading and discharging, storage and handling of dangerous goods are critical operations in all ports and terminals. These critical operations require specific operating procedures that depend on the types of dangerous goods, their form (solid, liquid or gas) and the way they are supplied, in bulk or as packaged. For all dangerous goods, at least the following needs to be considered:

- safe storage
- chemical and physical properties
- hazardous properties
- PPE availability
- material to contain, absorb liquid spills
- firefighting equipment

1. Receiving and Delivering Liquid Bulk

Loading and discharging liquid bulk requires careful attention. Operators need to consider many factors such as the temperature of the cargo, loading/discharging sequences, maximum filling levels and transfer rates, quantity of cargo and maximum manifold pressure.

The risk register evaluated the procedures at ports and terminals, safe operating procedures for the receiving and delivering of liquid bulk. The failure to implement procedures and the absence of supervision and communications can lead to operational errors which can increase the risks of commercial loss, property damage, pollution and safety.

2. Storing Liquid Bulk

The main hazards associated with storage of liquid bulks relate to tank separation not complying with standards and tank rupture due to internal corrosion, which can lead to release of storage tank content such as flammable liquids and explosive vapours. An insufficient area to contain spills (primary containment or bunding) can increase further the risks of pollution.

3. Receiving and Storing Dry Bulk

Not following operating procedures or not having personnel safety measures in place during loading increases the risk of personnel injury or fatality and also delays operations leading to commercial loss.

4. Receiving and Delivering Packaged Dangerous Goods

The risk register determined whether operating procedures are in place for the handling of packaged dangerous goods. If these are not handled correctly or fall during operations, they can be damaged and pose risks to personnel and, depending on the types of dangerous goods, may increase the risks of fire and explosion. Operational errors can delay operations. If packaged dangerous goods are damaged, time will be lost in taking remedial action.

5. Storing and Segregating Packaged Dangerous Goods

Storing dangerous goods requires measures to protect employees, property and the environment from risks. The most important of these requirements relate to building construction and equipment segregation goods. Facilities for storing dangerous goods should be properly identified with labels or placards, equipped with suitable emergency equipment and secured to prevent spillages or leakages have adverse effects, notably on the environment. Dangerous goods may react with other dangerous goods, chemicals or other substances. Liquids should not be stored above solids as escaping liquids may damage or penetrate packages below.

Dangerous goods incompatible with other substances must be segregated to prevent serious incidents from loss of containment or interaction. The International Maritime Organization (IMO) has published recommendations for segregating dangerous cargoes in port areas[17]. The absence of safe operating procedures or designated storage areas for packaged dangerous goods increases the chances for incompatible materials to mix and produce dangerous chemical reactions, putting property, personnel and the environment at risk.

6. Monitoring and Control of Storage Areas

The storage and handling of dangerous good requires ports and terminals to maintain a dangerous goods register, Material Safety Data Sheets (MSDS) for products, monitoring and inspection of storage areas and appropriate signs. In case of an emergency, local fire authorities and port and terminal management need to know the exact location, quantity and type of all dangerous goods stored at the site. Not having this information readily available at the time of an incident can have severe consequences, increasing the risks of fire and explosion endangering personnel, local communities and the environment.

3.2.2.5 Maintenance

Maintenance is related to fixing, repairing and service of devices and equipment. Maintenance should be performed on planned schedules and records should be kept. Maintenance and servicing of equipment is important in all heavy industries particularly ports and terminals that are handling large quantities of dangerous goods.

1. Maintenance of Equipment

The risk register determined whether there was a planned maintenance system for all equipment and procedures for performing maintenance and inspecting equipment prior to commencing activities and tasks. The failure to maintain port and terminal equipment regularly increases the risk of equipment breaking down, delaying operations and compromising the safety of personnel.

[17] IMO Ref. T3/1.02 MSC.1 Circ 1216 Recommendations on the safe transport of dangerous cargoes and related activities in port Areas. p. 44

2. Hot Work

Performing hot work in a port and terminal is a high risk activity and must be controlled. The risk register evaluated whether there was a hot work permit system in place. A hot work permit sytem ensures that hot works must be approved prior to commencement of the task. The permit system also ensures that hot works are not carried out during loading and discharging without permission, so that additional safety measures can be implemented. The possible consequences of personnel or contractors undertaking hot work can be severe as sparks and ignition sources can be generated increasing the risks of fire, explosion, pollution, personnel injury and fatalities.

3.2.2.6 Human Factors

Human factors are all factors that can have influence or affect the capacity of a person to perform a certain task/operation.

1. Working Hours

It is important that working hours are managed at ports and terminals. Operators working long hours can suffer from fatigue and are more likely to make mistakes and be less alert with reduced concentration.

2. Education

Personnel working at ports and terminals should be educated to understand operations and the hazards and risks associated. Failure to appreciate the risks may lead to unsafe work practices, endangering themselves and other personnel. It is particularly important for personnel to understand the risks of handling dangerous goods.

3. Experience

Experience of personnel must be considered at ports and terminals. Those with more experience should supervise other employees to ensure operations are completed safely and without delay. Inexperienced personnel carrying out tasks without supervision can increase operational error and mistakes, leading to commercial losses, property damage, pollution and risks to safety.

4. Training

Personnel working at ports and terminals cannot gain experience or be competent to perform tasks and activities and respond to emergencies without adequate training and supervision. Training is required for handling dangerous goods, PPE use, emergency response, first aid, firefighting and risk assessment. It is important that refresher courses, drills and exercises are completed to maintain skills and competencies. Personnel without adequate training are more likely to make operational errors, underestimate risks and not be able to respond in emergencies, increasing the risk of injuries, fatalities, pollution, fires and explosions.

5. Communication and Information

It is the responsibility of port and terminal management to inform personnel about the hazards and risks associated with tasks, activities and critical operations. The risk register determined whether the ports and terminals had accident records and hazard inspections. Personnel not aware of the hazards cannot control the risks with consequences such as operational errors and mistakes which can compromise safety, the environment and operations. It is also important that communications between port personnel and vessel crew consider language differences, particularly with international trade of dangerous goods since this can be another cause of operational error and miscommunication.

3.2.2.7 Management and Regulations

Management is one of the most important hazard groups of the risk register. Terminal management should provide a safe and healthy working environment and ensure that all operations and activities are conducted with minimum effects on the environment while complying with the regulatory framework in Member Countries where rules and regulations exist. The National Working Groups were required to evaluate the following components of management at the ports and terminals:

1. Safety and Quality

The risk register evaluated the level of safety and quality management at ports and terminals including safety and environmental procedures, health and safety committee and advisors. The absence of safety and quality management systems increases operational error, mistakes and means that management and personnel do not have a systemized way to complete tasks and activities. Safety and quality management systems also require that management and personnel assess the risks associated with activities and control measures to implement prevention and mitigation measures. Not having an adequate safety and quality management system increases the risk of incidents; pollution, safety and can decrease the efficiency of operations.

2. Inspections

It is important that inspections of ports and terminals are carried out in a planned manner. The failure to carry out inspections can lead to deficiencies being overlooked and hazards not being identified and assessed appropriately, increasing the risks of incidents and commercial loss.

3. Regulations

Port regulations are usually issued by a public port authority. They provide detailed regulations relating to the conduct of vessels, safety and order in the port area, protection of the environment, the use of pilots and documentation for the loading and discharging of goods. An absence of regulations means that ports and terminals have no guidance on how to manage operations safely

4. Ports and Terminal Policy

Ports and terminal must be committed to safe operations, minimising harm to personnel, the environment and local communities and complying with relevant regulations and standards. The port and terminal policy to invest in prevention and mitigation measures and monitor safety and the environment will increase the standards and efficiency of operations and reduce impacts.

5. Security

Ports and terminals receiving seagoing and international vessels should implement the International Ship and Port Facility Security (ISPS) Code. Security and access to ports and terminals need to be controlled to reduce the risks of property damage, contamination or acts of terrorism.

6. Emergency Response

Ports and terminals should have procedures ready for immediate implementation in case of emergency. These procedures should cover all type of emergencies that can be expected for example; a major oil spill or cargo leaks that result in a fire or explosion. The risk register determines whether the ports and terminals have emergency response plan, drills or have adequate emergency response and oil spill equipment. If there is not sufficient emergency response systems in place the port and terminal cannot respond effectively to emergency and oil spills, increasing the risks to personnel, environment and local communities as the emergency situation becomes uncontrollable.

7. Authority Control and Law Enforcement

The primary goal of authority control and law enforcement is to verify if the port and terminals comply with all existing rules, regulations and standards that apply. When they fail to comply, the authority must be able to impose significant penalties and force port and terminal management to either rectify the situation within a certain time period or suspend operations if the failure to comply poses severe threats to safety or the environment.

The port and terminal must also be monitored and inspected by competent authorities to ensure compliance with regulations and technical standards where they exist. Terminals and ports may have adequate safety and quality management systems and comply with regulations and technical standards; however it is critical that sites are assessed by competent authorities and third party audits.

8. Checklists

The risk register determined whether checklists were available at ports and terminals to complete before starting tasks and activities, particularly operations involving the storage and handling of dangerous goods. Checklists should be available for vessel shore safety, bunkering and disposal of hazardous materials. Checklists are important for personnel to ensure they know the tasks, PPE to be worn and the hazards and associated risks. Having no checklist in place increases the risks of incorrectly sequencing tasks, no safety controls, miscommunications leading to incidents.

9. Waste Management

The management of wastes at ports and terminals is very important. Ports and terminals should provide facilities and services for the reception of waste from vessels. The environmental outcome will otherwise be inappropriate disposal of waste generated by vessels and the port or terminal. Wastes from vessels are mostly cargo residues collected in the slop tanks, waste oil from maintenance operations and garbage. Waste generated by port and terminals can be waste oil from maintenance operations, cargo residues collected in drip trays and garbage.

Having no waste management system in place for all the wastes listed above will be a direct source of pollution to the Mekong River. If the waste is not cleaned up following operations, cargo residue and wastes will enter the river as run-off during storms as an indirect source of pollution.

10. Drugs and Alcohol

Drug and alcohol policies are important for ports and terminals as personnel under the influence of drugs and alcohol are more likely to make operation errors, mistakes, they have decreased reaction time and will not only endanger their own lives, but those of other personnel.

3.2.2.8 Global Events

Global events are natural disasters or uncontrollable external factors which can compromise the safe operation of ports and terminals, damage infrastructure and lead to catastrophic incidents. One third of all petroleum tank fires are due to lightning strikes.[18] Floating roof tanks (FRTs), as seen in Figure 32, can be especially vulnerable to lightning strikes. The costs can be catastrophic, with loss of product, equipment, production and life. Ports and terminals can consider contingency plans for flooding, lightning, mud slides, monsoons, typhoons high winds, tsunamis, tidal waves and earthquakes.

3.2.2.9 Additional Hazards

A section on the risk register was provided for any additional hazards identified by the National WG.

Figure 32: **Lightning Strikes Fuel Storage Tank**[19]

[18] Journal of Loss Prevention in the process industries: A study of storage tank accidents, James I., Cheng-Chung Lin

[19] http://www.engineerlive.com/Oil-and-Gas-Engineer/Safety/Preventing_petroleum_tank_lightning_strikes/23264/

3.3 RISK EVALUATION

3.3.1 Introduction

As explained in Section 2.6 (Risk Evaluation), the results from the nine hazard groups in the risk register for ports/terminals and ferry crossings were compared to risk criteria to determine priority implementation areas. The following section evaluates the storage and handling of dangerous goods in ports, terminals and ferry crossings in the MRC Member Countries. The section also provides an overview of the existing legislation, type and quantity of dangerous goods handled and the location of ports and terminals.

3.3.2 International Agreements

There are two international agreements for navigation in the Mekong River that are described briefly below. The agreements and national legislation will be discussed further in the legal chapter.

The *Agreement on Commercial Navigation on Langcang-Mekong River* (Tachileik, Shan State [East], 20 April 2000) applies to the Upper Mekong (People's Republic of China, Lao PDR, Myanmar and Thailand) and contains the following main points on the storage or handling of dangerous goods:

- The Agreement prohibits the carriage of toxic chemicals, explosives and radioactive material on the Upper Mekong. Other types and categories of dangerous goods are only allowed when agreed upon among the contracting parties.
- The Agreement was supplemented by six technical annexes that contain specific references to dangerous goods:
  - Regulations on safe navigation of vessels on the Lancang-Mekong River stipulate that vessels carrying dangerous goods have to exhibit an all round red light at night and the Code Flag "B" at daytime during berthing, loading and unloading or navigation.
  - Rules on water transport administration on the Lancang-Mekong River stipulate that:
    - the carriage of dangerous goods such as explosives, poisonous and infectious substances and radioactive materials shall be prohibited;
    - packaging and protection requirements for dangerous goods comply with the IMDG Code;
    - the shipping name shall be displayed on packages of dangerous goods with the name complying with the individual schedules of the IMDG Code and with labels and marks as required by the IMDG Code;
    - transport documents for dangerous goods shall meet IMDG Code requirements; and
    - Transport of dangerous goods is not allowed on passenger or non-steel vessels.

The *Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Vietnam on Waterway Transportation* (Phnom Penh, 17 December 2009) contains several references concerning the storage and handling of dangerous goods:

- For commercial goods for cross-border transportation, the IMDG Code should be consulted and used as the main reference to determine if these goods are to be classified as dangerous goods;

- For cross-border transportation, it is compulsory for inland waterway vessels to have a special permit for the carriage of dangerous goods with a maximum validity of 60 days;
- Pilots are compulsory for every inland waterway vessel carrying dangerous goods engaged in cross-border navigation, regardless of tonnage, dimensions or port of call;
- Competent authorities of both countries have the right to enforce current existing laws and regulations relating to the transportation of dangerous goods but due consideration of freedom of navigation needs to be guaranteed; and
- The Mekong Facilitation Committee will assist in drafting new laws, rules and regulations and, if necessary, revise existing laws rules and regulations to harmonise them.

3.3.3 Cambodia

3.3.3.1 Legislation and Authority Control

The National Working Group members in the MRC Member Countries were required to complete questionnaires in relation to national legislation and authorities responsible for implementing and enforcing rules, regulations and decrees. Following the answers to the questionnaire, it can be concluded that there is no specific national legislation (rules, regulations, decrees) concerning the handling and storage of dangerous cargo in port areas or petroleum terminals. The Ministry of Public Works and Transport (MPWT) is responsible for preparing the national legislation in regards to inland waterway transport. It should be noted however that Cambodia is a party to the *Safety of Life at Sea (SOLAS) Convention* which has been both signed and ratified by Cambodia so it can be deemed to form part of Cambodian domestic law.[20, 21]

Any port, terminal and other industry developments are required to have an EIA (environmental impact assessment) certificate. EIA is a process for analysing the potential environmental impacts for proposed and existing projects. The main objectives of an EIA are to:

- ensure environmental aspects and impacts are considered before decisions are made;
- promote sustainable development; and
- prevent adverse environmental effects from the activities of the project.

Legislation on EIA is governed by the *Law on Environmental Protection and Natural Resource Management*[22]. In general, the EIA process takes 6 months and the Ministry of Environment (MoE) is mainly responsible for approval with support from other ministries. Further information on the legal framework for EIA and NRM is provided in the environment chapter. The overall process for environmental management is controlled by the MoE.

It was determined that there was no specific information relating to the persons who are responsible for the safety in ports at the national level. The National Working Group conducted some research and interviewed port and terminal operators and found that each port and terminal is responsible for implementing their own procedures for safety and security. Phnom Penh Autonomous Port (PPAP) has

[20] IMO, Status of Multilateral Conventions, etc. As of 01 August 2011 pp 79

[21] Online text at: http://www.imo.org/About/Conventions/StatusOfConventions/Documents/Status%20-%202011.pdf
Constitution of Cambodia article 90

[22] Online text at: http://www.mekonglawcenter.org/download/0/cambodia.htm

a safety and security department. At the petroleum terminals, the terminal manager is responsible for health safety and environment (HSE) management with support from the administration department. One of the petroleum terminals surveyed has a Health Safety and Environment (HSE) Manager who is responsible for implementing and monitoring HSE management systems across the business operations.

The administration department of each port and terminal is responsible for the implementation and compliance with port laws, by-laws and regulations relating to the transport, handling and storage of dangerous goods in port areas. The National Working Groups also determined that there are no penalties, fines or other punitive actions for the ports and terminals that do not comply with the applicable rules and regulations. There is currently limited capacity and resources within the ministry to monitor and enforce national rules and regulations. The MPWT is working to improve the management of ports, terminals and vessels in Cambodia and has recently issued the following policy statement:

"*The government is committed to develop maritime transport and port laws and regulations as well as monitoring and enforcement mechanism for all relevant international conventions and rules. To that effect, existing regulations are being updated and augmented to comply with international maritime conventions to which Cambodia is a party. A maritime law will be enacted and mechanisms set in place to ensure its implementation. It is planned to improve and update port policy and port laws and to develop a legal framework for private port operation*."[23]

This policy looks promising but for the moment there is no actual information available on the status of execution of this policy and how it will be implemented. In the master plan for waterborne transport on the Mekong River system in Cambodia dated November 2006, there is reference to the draft of a Cambodia maritime law. This draft should have been completed in 2007. The current status of this draft is, however, unclear.

The MPWT established a draft of the *Prakas for Carriage of Dangerous Goods by Inland Waterway in the Kingdom of Cambodia* in June 2011. The MPWT is also currently drafting the *Prakas on the Formation of Private Port Management Commission*.

The Commission on Private Port Management, chaired by the Minister of Public Works and Transport, is being established to manage the development, order and ensuring proper operation of private ports. Article 3 describes that the role and responsibilities of the commission are to:

- make necessary policy proposals for the development and operation of private ports;
- make proposals to establish laws/sub-decrees, or adopt draft *Prakas*/circulars concerning the development and the operation of private ports. The development and operation of private ports should be consistent with the National Port System in order to ensure safety, security and environmental protection;
- check and adopt the port development plans;
- control the management and the operation of private ports through annual reports; and
- facilitate with all relevant authorities and agencies for ensuring smooth and effective operations and services of private ports.

The following decrees are relevant to the risk analysis:

- *Sub-Decree Nº 218 (RGC) of December 24, 2008 on the Establishment of Cambodian Maritime Institute (CMI)* (Ogs, Year 08, N095, December 27, 2008).

[23] Online text at: http://www.mpwt.gov.kh/detail_eng/transportpolicywater.html

This sub-decree aims to establish the Cambodia Maritime Institute (CMI) to provide naval training in Cambodia at the bachelor, associate and post-graduate degree level. This institute is under the supervision on the Phnom Penh Autonomous Port (PPAP) and under the protectorate of MPWT. It comprises five faculties such as piloting, transportation management, port management and operation sciences, and construction.

3.3.3.2 Dangerous Goods Specifications

Trade is increasing through the Phnom Penh Autonomous Port (PPAP) as illustrated in Figure 33 below which shows the actual and estimated number of containers from 2005-2013.

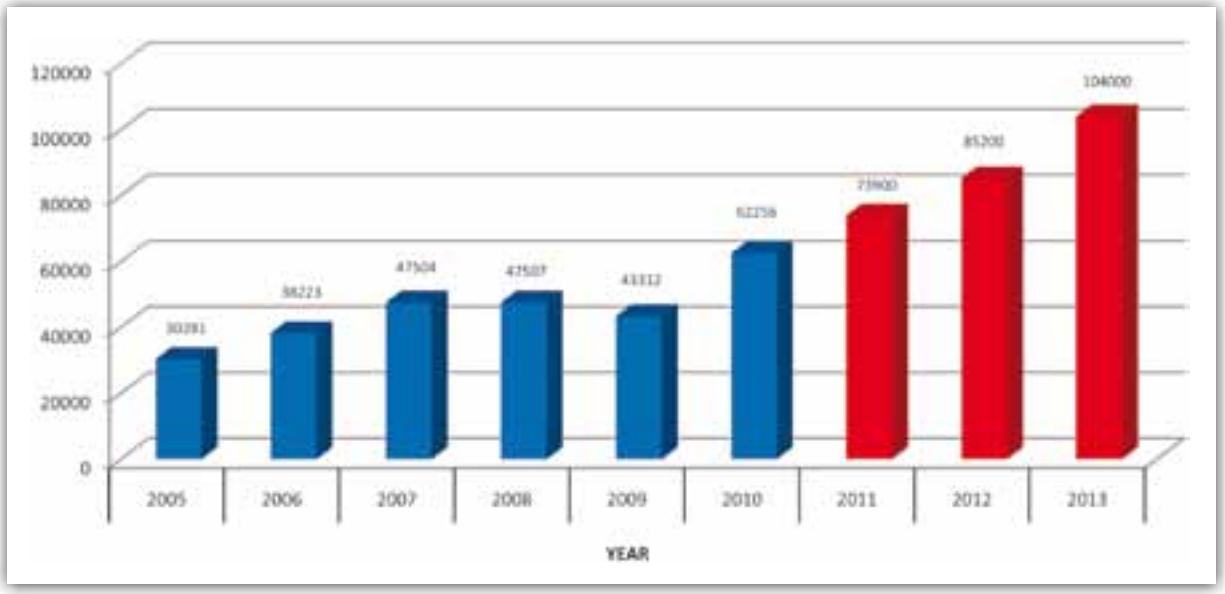

Figure 33: **Actual and Estimated Number of Containers 2005 - 2013**

The blue bars indicate the actual number of containers handled at PPAP from 2005-2010 and the red bars represent the estimated amount of containers that may be handled in the future. For 2010, the actual number of containers handled at PPAP was 62,256 units. Estimated containers that will be handled at PPAP in 2013 will further increase to 104, 000 units.[24] In 1996, the IMO estimated that 10 to 15 percent of the cargo transported by water were dangerous goods in packaged form and that this was increasing every year. Since a considerable amount of dangerous goods in packaged form is transported by means of containers, it is worth investigating the total container throughput of containers at PPAP. There is limited information available on the amount of containers that contain dangerous goods.

The different kinds of dangerous goods presently stored and transported on the Mekong River system in Cambodia are:

- fuel oil (FO)
- diesel oil (DO)

[24] http://www.ppap.com.kh/port_status.htm

- kerosene oil (KO)
- motor gasoline (MOGAS: M92, M95 and M97)
- jet fuel (Jet A-1)
- liquid petroleum gas (LPG)
- ammonium nitrate and fertilisers; and
- packaged dangerous goods in containers.

Table 13 below provides an overview of the type and quantities of dangerous goods imported through PPAP from the Mekong River in Viet Nam between 2008 and 2010.

Table 13: **Type and Quantity of Dangerous Goods in Litres (2008-2010)**

TYPE OF DANGEROUS GOODS	QUANTITY OF DANGEROUS GOODS IN LITRES			
	2008	2009	2010	Total
Fuel Oil	292,380,026	33,693,208	11,635,545	337,708,779
Diesel Oil	278,995,184	371,909,075	389,157,541	1,040,061,800
Kerosene Oil	66,803,370	208,878,982	117,116,910	392,799,262
Motor Gasoline	180,185,039	231,460,393	205,611,616	617,257,048
Jet fuel	860,778	14,634,755	18,787,141	34,282,674
Liquefied Petroleum Gas	2,870,139	4,242,525	2,768,728	9,881,392
Fertilisers	800,000	3,480,600	0	4,280,600
Other Dangerous Goods	0	3,276,902	45,439,469	48,716,371
TOTAL	**882,894,356**	**868,0299,538**	**745,077,481**	**2,436,271,555**

Source: Phnom Penh Port Authority

3.3.3.3 Petroleum Terminals

In Cambodia, currently 80 percent of petroleum products including diesel oil, M92, M95, jet fuel, intermediate fuel oil and LPG is transported from Ho Chi Minh City, Viet Nam, along the Mekong River to Phnom Penh. For the moment, Cambodia has currently no oil production. There are, however, reasonable amounts of oil (about 2 billion barrels) and significant quantities of natural gas found (on and offshore) in Cambodia. Petroleum extraction is estimated to be online by 2012-2013.[25] There are 12 petroleum terminals along the Mekong and Tonle Sap rivers (Figure 34) that supply fuel through the commercial distribution networks:

[25] http://www.asiapacificmemo.ca/cambodia-resource-curse

Figure 34: **Location of Petroleum Terminals in Cambodia**

Tonle Sap (TS):

1. **Sokimex Russey Keo Terminal** (Km 6, TS7): Road Number 5, Sangkat Russey Keo, Khan Russey Keo, Phnom Penh
2. **Savimex Terminal** (Km 7, TS9): Road Number 5, Sangkat Km 6, Khan Russey Keo, Phnom Penh
3. **Gas Terminal** (Prek Pnoeu Km 9, TS 15): Road Number 5, Sangkat Prek Pnoev, Ponhea Leu District, Kandal Province.
4. **Tela Terminal** (Prek Pnoev Km 11, TS17): Road Number 5, Sangkat Prek Pnoev, Ponhea Leu District, Kandal Province
5. **Bright Victory Terminal** (Prek Pnoev, TS 19): Sangkat Prek Pnoev, Ponhea Leu District, Kandal Province

Upper Mekong (UM):

6. **Mekong Bright Victory Terminal** (UM1): Road Number 6A, Bakeng Village, Moukampoul District, Kandal Province.
7. **Tonle Bet Terminal** (UM2): Tonle Bet, Kompong Cham Province.

Lower Mekong (LM):

8. **Total Terminal** (Khsom Village, LM11): Road Number 1, Banteay Dek Commune, Kien Svay District, Kandal Province.
9. **Petronas Terminal** (Chruoy Dang Village, LM19) : Road Number 1, Chruoy Dang Village, Samrong Thom Commune, Kien Svay District, Kandal Province.
10. **L H R Asia Investment Terminal** (Preksay Village, LM) : Road Number 11, Preksay Leu Village, Peam Ror Commune, Peam Ror District, Prey Veng Province.
11. **Sokimex Preksay** Terminal (Preksay Village, LM2) : Road Number 11, Preksay Leu Village, Preksay Commune, Peam Ror District, Prey Veng Province.

Tonle Bassac (TB):

12. **EDC Kalmax Factory Terminal** (TB2) : Road Number 2, Chak Angre Village, Chak Angre Commune, Meanchey District, Phnom Penh

To complete the risk register, the National Working Group visited and inspected four sites. Three petroleum terminals and one IWT port handling mostly containers were included in the risk assessment:

- **Terminal 1** had 26 tanks for the storage of petroleum products of which 16 were in use. Ten tanks had been temporarily decommissioned for maintenance and repair. Petroleum products stored and handled at the facility were Jet A1, DO, M92 and M95. This terminal also supplied heavy fuel oil on small tankers to industry for power generation on the Mekong and Bassac Rivers;
- **Terminal 2** had 10 tanks for the storage of petroleum products representing a total capacity of 16,450 m^3 including 2 tanks of 4,000 m^3, 2 tanks of 3,000 m^3 and 1 tank of 1,700 m^3. There were also 5 much smaller tanks of 150 m^3. Petroleum products stored and handled at the facility were Jet A-1, DO, MOGAS (M92 & M95) and LPG. There were 18 employees working at the facility;
- **Terminal 3** stored and handled gasoline (M92 & M95), FO, KO and LPG in tanks of 10,000 m^3, diesel in tanks of 5,000 m^3 and gasoline in tanks of 1,500 m^3. The capacity of the whole terminal was 95,000 m^3. The terminal also owned and operated three 460T tankers supplying diesel from Phnom Penh to Chhong Kneas during the high-water season, making approximately 20 trips monthly.
- **Phnom Penh Autonomous Port (PPAP)** is an international port on the Tonle Sap River 2 km upstream from the Chaktomuk confluence in central Phnom Penh. It is connected to the South China Sea via the Bassac River (Song Hau) and the mainstream of the Mekong (Tieng Giang). The access distance to the port is about 332 km from the Cuu Tieu mouth of the Bassac in the South China Sea and about 100 km from Kaam Samnor, on the Cambodian side of the Viet Nam border on the Mekong mainstream. The port handles mainly containers and general cargo. Dangerous goods that are handled and stored at the premises include fertiliser, toluene, ammonium nitrate and acetic acid (Figure 35).

Figure 35: **Phnom Penh Autonomous Port**

A ceremony for the construction of a new container dock of the Phnom Penh Autonomous Port was held on 9 March 2011. The new dock is located in Kandal Leu village, Banteay Dek commune, Kien Svay district, Kandal province and is financed by a loan from the Government of the People's Republic of China. According to the Minister of Public Works and Transport, the proposed construction area will cover an area of 6,600 m^2 with 10 ha of container docks including an administrative office and water and electricity network. The site is located along the Mekong River and the National Road No 1 of Kandal province, 30 km east of Phnom Penh. The new container dock will allow the docking of two 5,000 -tonne vessels simultaneously, with capacity of 120,000 TEUs per annum[26] in the phase and 300,000 TEUs per annum when fully developed (Figure 36).

[26] http://www.cnv.org.kh/2011_releases/09mar11_container_dock_port_speech.html

Figure 36: **Master Plan of New Phnom Penh Port**

3.3.3.4 Risk Evaluation for Ports, Terminals and Additional Operations

Upon completion of the risk assessment by the National Working Group, the data collected and risk registers were analysed and used to compile a typical risk register. This typical risk register represents the current status of an average terminal in Cambodia. As only one major port was assessed, the data of this port was used to compile an average risk register of an average port in Cambodia. These findings can be used to assess the safety and environmental protection of future ports developments in IWT.

Priority Areas were derived by comparing the existing levels of risk control measures in MRC Member Countries identified in the risk registers with international benchmarks and possible impacts including fire, explosion, pollution and loss of life (for detailed explanation see section *2.6.2 Priority Areas*).

The information was represented for each hazard group for ports and terminals, illustrating the activity/ operations, possible hazards, possible consequences and priority area. Only Priority areas 2, 3 and 4 were included as interventions as this needs to be done in the short to medium term.

One of the terminals visited had very limited controls and was used as a basis to prepare the Priority Areas (see Table 14 starting overleaf).

Table 14: **Priority Areas – Cambodia - Average Terminal**

CAMBODIA AVERAGE TERMINAL		
No.	**Hazard**	**Priority Area**
1101	Terminal close to residential area	4
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	
1403	Cargo pump leaking	
1501	Cargo transfer hose is ruptured	
1502	Cargo pipe fractured	
1503	Piping subject to surge pressure	
1504	Transfer hose leaking	
1506	Safety devices not working (ex. Emergency Shutdown system not working)	
1509	Lines not in use not properly blinded (flange connected with all bolts tight)	
1510	Gaskets, seals or flanges leaking	
1605	Emergency valves not readily accessible	
11104	Portable firefighting equipment - Legal requirements not met	
11201	Fire detection equipment not working	
11202	Fire detection equipment not regularly tested	
11501	No emergency equipment available	
11502	Emergency equipment not sufficient	
11505	No emergency control centre	
2101	Tank high level alarm out of order	
3202	Mechanical damage to cables	
3203	Cables not fire proof	
3301	Electrical equipment and installations do not comply with the standards recognised by the competent authority	
3302	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	
3303	Electrical equipment and installations are not properly operated	
3304	Electrical equipment not properly earthed	
3305	No adequate lighting	
3401	Circuit breakers not adequate for circuit protection	
3402	Circuit breakers not working	
6303	No training for operators to complete task	
6402-6403	No correct training course provided, no special training on handling DG	
6501	Accidents / hazards not communicated	
6502	No records of Accidents / hazards	
6503	Accidents / hazards not reported	
7101	No or limited safety, environmental procedures for terminal operations	

Table 14: **Priority Areas – Cambodia - Average Terminal (continued)**

No.	Hazard	Priority Area
7102	Improper or inadequate procedures are in use	
7301	No Authority control	4
7401	Terminal has no policy, bad management	
7602	No emergency response drills	
7603	No or inadequate Emergency Response equipment	
7701	Terminal personnel not properly trained on handling DG	
7706-7707	No training marine pollution prevention and environmental protection	
7708	No training on vessel waste management	
7801	No law enforcement	
7901	No regulations	
7902	Operator not aware of National regulation	
71001	No checklist regarding loading and discharging operations	
71102	No approved code of safe working practice available	
71201-71202	No solid and liquid waste management	
71201-71202	No solid and liquid waste management	
1301	Failing tank structure (ex. Tank supporting, corrosion, etc)	3
1402	Cargo pump fail to start/stop on demand	
1404	No regular inspection of cargo pumps	
1505	Maximum Allowable Pressure (MAWP exceeded)	
1507	Pressure gauges on cargo pipes not working	
1508	Safety systems manually by-passed	
1517	Piping not properly supported	
1519	No flame arrestors on vent lines	
1520	Cargo pipes not regularly pressure tested	
1601	Cargo valves blocked	
1602	Cargo valves fail to operate	
1603	Cargo valve leaking	
1606	Valves not fire rated	
1701	Warehouses/sheds not equipped with firefighting equipment	
1703	Floor/surface of warehouses/sheds not suitable for storing DG	
1901	No waste reception facilities available for vessels	
11003	No international shore connection available	
11006	Fixed firefighting pump capacity not sufficient	
11102	Portable firefighting equipment not regularly inspected/tested	
11103	Portable firefighting equipment not colour-coded	
11105	Incorrect firefighting equipment used	
11107	Firefighting equipment not working	
11401	No correct Personal protective equipment (PPE) provided	
11402	PPE not maintained according manufacturers recommendations	
11404	Safety showers not working	
11504	Spillage control equipment not sufficient	
2102	Tank high level alarm not calibrated	

Table 14: **Priority Areas – Cambodia - Average Terminal (continued)**

No.	Hazard	Priority Area
2202-2205-2301	Leaking valves on tank wagons / tank trucks containing DG	3
2302	Rupture of tank or welding seam	
2401	No Walky - Talkies available	
2403	Communication with cargo control room not working	
2501-2705	Emmision of electric spark from trucks/trailers/generators	
2704	Generator alarm/shutdown fails	
3201	Not enough clearance for overhead power lines	
4104	No supervisions during cargo operations	
4701-4702-4703	No dangerous goods register, register not up to date and no MSDS available	
5102	Terminal equipment not inspected as scheduled	
5104	No maintenance system in place	
5106	No procedures for opening process equipment/piping	
5201	Hot work permit not in use	
6201	Operator does not understand/know the hazards of the process	
6202	No education corresponding to job requirements	
6301	New operating staff not properly trained	
6302	No procedures in place to ensure operators perform a task as required	
6401	No training on correct use of PPE	
6404	No refresher training on handling DG	
7201	Improper/inadequate inspections of terminal	
7501	ISPS Code not in use/implemented	
7601	No measures in place to deal with DG spillage (Emergency Response Plan)	
7703-7704-7705	Training on firefighting equipment, emergency response procedures and accident prevention	
7709	No refreshment courses for terminal personnel handling DG	
71002-71003-71004-71005	No checklist regarding: cargo transfer, bunkering, maintenance and safety items	
71101	No management system in use	
71103	No management concerning DG	
71301	No drug and alcohol policy	
8106	Global events: high winds	

Table 14: **Priority Areas – Cambodia - Average Terminal (continued)**

No.	Hazard	Priority Area
1511	No colour coding on cargo pipes	2
1512	Pipe welding insufficient	
1513	Piping located in areas with high vehicle traffic not separated from traffic flow by vehicle guards or earthen beams	
1514	Hot steam line not insulated	
1515	Construction material not corrosion resistant	
1516	Piping specifications not followed	
1518	Corrosion rates not regularly checked	
1902	Capacity of waste reception facilities insufficient	
1903	Waste generated by port and cargo operations	
2303	Malfunctioning of meters on tank trucks	
6504	Language difference between terminal operator and vessel crew	
8102-8105-8108	Global events: lightning, typhoons, high winds and earthquakes	

The existing conditions a the the Phnom Penh Port were also evaluated, the results are illustrated (Table 15) below:

Table 15: **Priority Areas - Phnom Penh Port**

CAMBODIA PHNOM PENH PORT		
No.	**Hazard**	**Priority Area**
1702	Segregation of DG not according regulations	4
11201	Fire detection equipment not working	
11202	Fire detection equipment not regularly tested	
11505	No emergency control centre	
4301	Operating procedures for receiving/delivering dry bulk not followed	
4302-4401	No personal safety measures during receiving/delivering/storage of dry bulk	
4601	Incompatible DG not segregated	
6502	No records of accidents/Hazards	
6503	Accidents / hazards not reported	
7301	No Authority control	
7602	No emergency response drills	
7706-7707-7708	No training marine pollution prevention, environmental protection and vessel waste management	
7801	No law enforcement	
7902	Operator not aware of National regulation	
71001-71002 71003-71004 71005	No checklist regarding: loading/discharging, cargo transfer, bunkering and maintenance and safety items	

Table 15: **Priority Areas - Phnom Penh Port (continued)**

No.	Hazard	Priority Area
1102	Trucks loaded with DG going to and from the terminal, passing densely populated areas	3
1701	Warehouses/sheds not equipped with firefighting equipment	
1702	Segregation of DG not according regulations	
1703	Floor/surface of warehouses/sheds not suitable for storing DG	
1801	Crane used beyond designed capacity, Safe Working Load (SWL) exceeded	
1803	Slings for crane not of approved type	
1804	Cranes not inspected/tested at regular intervals	
1805	Limit & safety devices of cranes not working	
11101	No portable firefighting equipment stand-by	
11102	Portable firefighting equipment not regularly inspected/tested	
11103	Portable firefighting equipment not	
11104	Portable firefighting equipment - Legal requirements not met	
11105	Incorrect firefighting equipment used	
11501	No emergency equipment available	
11502	Emergency equipment not sufficient	
11503	No spillage control equipment available	
11504	Spillage control equipment not sufficient	
2502-2503-2504	Packaged DG falling from truck due to improper securing	
3101	High voltage cables are unprotected or badly insulated	
3303	Electrical equipment and installations are not properly operated	
4501	Operating procedures for delivering/receiving packaged DG not followed	
4502	Packaged DG falling or damaged during handling by forklift, crane, etc.	
4602	Package of DG damaged during handling/storage, hazardous reaction due to contamination	
4604	No safety procedures for storing DG	
4701-4702-4703	No dangerous goods register, register not up to date and no MSDS available	
5104	No maintenance system in place	
6201	Operator does not understand/know the hazards of the process	
6202	No education corresponding to job requirements	
6301	New operating staff not properly trained	
6402-6403-6404	No correct training course provided, no special training on handling DG, no refresher training provided	
6405	No regular emergency drills conducted	
6501	Accidents hazards not communicated	
7101	No or limited safety, environmental procedures for terminal operations	
7102	Improper or inadequate procedures are in use	
7603	No or inadequate Emergency Response equipment	
7701	Terminal personnel not properly trained on handling DG	

Table 15: **Priority Areas - Phnom Penh Port (continued)**

No.	Hazard	Priority Area
7703-7704	Training on firefighting equipment and emergency response procedures	3
7709	No refresher training on handling DG	
7901	No regulations	
71101	No management system in use	
71102	No approved code of safe working practice available	
71103	No management concerning DG	
8106	Global events: high winds	
1101	Terminal close to residential area	2
1201-1202	Access to port facilities uncontrolled, no surrounding wall, no fence, no controlled gate	
1806	Maximum load capacity of slings used less than maximum capacity of the crane	
1807	Cranes not certified	
11107	Firefighting equipment not working	
2501	Emission of electric spark from trucks/trailers	
2601	Forklifts & reach stackers emitting electric sparks	
2602	Equipment used beyond rated capacity, packaged DG falling off	
2603	Equipment malfunction due to no or improper maintenance, packaged DG falling off	
3102	High voltage cables in areas were inflammable goods are handled or stored are unprotected or badly insulated	
3201	Not enough clearance for overhead power lines	
3203	Cables not fire proof	
3301	Electrical equipment and installations do not comply with the standards recognised by the competent authority	
3302	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	
3305	No adequate lighting	
3401	Circuit breakers not adequate for circuit protection	
3402	Circuit breakers not working	
4603	No proper containers used for storing DG	
4605	Surface not suitable for storing packaged DG	
6303	No training for operators to complete task	
6305	Operator not provided with supervision	
6504	Language difference between terminal operator and vessel crew	
7401	Terminal has no policy, bad management	
7601	No measures in place to deal with DG spillage (Emergency Response Plan)	
7705	No training on accident prevention	
8101-8102-8108	Global events: lightning, flooding and earthquakes	

ADDITIONAL ACTIVITIES AND OPERATIONS

Activity/Operations: Local Supply of Fuel
Location: Krakor, Cambodia

Figure 37: **Local Supply of Fuel in Krakor, Cambodia**

During the risk assessment, the National Working Group observed six small vessels (pictured above) that supply fuel to communities living in Krakor on the Tonle Sap. On average, each vessel carried 60 plastic containers (30 litres) of petroleum products totalling 1,800 litres. The boat operators stated that they operated for eight months during the wet season. Solid wastes from human activity were evident around the fuel supply operations. This is a small-scale operation. Cumulatively, however, there is a large amount of petroleum products supplied with very limited controls (Table 16).

Table 16: **Priority Areas for the Loading of Fuel**

No.	Possible Hazards	Possible Consequences	Priority Area
Local Supply of Fuel, Krakor			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures	**High (3)**
2	No safety procedures for the operations	Operational errors during fuel transfer, fire/ explosion, pollution	**Very High (4)**
3	Fuel hoses and petroleum drum not maintained	Spills during fuel transfer, pollution.	**Medium (2)**
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	**High (3)**
5	No waste reception facilities available.	Pollution, solid and liquid wastes disposed to the river.	**High (3)**

Activity/Operations: Transfer of Fuel from Truck to Barge
Location: Chhong Kneas, Cambodia

Figure 38: **Transfer of Fuel from Truck to Barge in Chhong Kneas, Cambodia**

In Chhong Kneas, also on the Tonle Sap, it was discovered that trucks supply fuel directly to barges (200 tonnes) during the eight-month high water season. The fuel is then transported to supply stations. There is no berthing facility for the barge and the operation is undertaken in close proximity to small passenger and tourist boats. There was evidence of oily wastes generated by the operations on the banks of the river. About 15,000 tonnes of fuel is transferred from the fuel trucks to the barges annually (Table 17).

Table 17: **Priority Areas for the Transfer of Fuel from Truck to Barge**

No.	Possible Hazards	Possible Consequences	Priority Area
Transfer of Fuel from Truck to Barge, Chhong Kneas			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures.	High (3)
2	No safety procedures for the operations	Operational errors during fuel transfer, fire/ explosion, pollution	High (3)
3	No adequate berthing facility for Barge	Pollution, solid and liquid wastes disposed to the river.	High (3)
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	High (3)
5	No waste reception facilities available for barge or fuel trucks.	Pollution, solid and liquid wastes disposed to the river.	Very High (4)
6	Operation in close proximity to small passenger vessels.	Endangering tourism operators in case of fire/ explosion/ toxic gas release	Very High (4)
7	No management concerning dangerous goods	Endangering property, employees, environment, due to negligence, unawareness	High (3)

FLOATING FUEL STATIONS

In Cambodia it was noted in the preparation meetings that during the high water season there are a number of floating and fixed fuel stations operating on the Great Lake. As the Tonle Sap Lake is a very important wetland and sensitive to water pollution, a sample of these re-fuelling stations were included in the Risk Analysis (Figure 39).

Figure 39: **Floating Fuel Terminals on Tonle Sap Lake, Cambodia**

Table 18: **Priority Areas for Floating Fuel Terminals, Cambodia**

No.	Possible Hazards	Possible Consequences	Priority Area
Management, Authority and Control			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures.	**Very High (4)**
2	There are no rules and regulations for the safe operation of terminals	Unsafe operating conditions, increasing risks of incidents	**High (3)**
3	No management concerning dangerous goods	Limited awareness of dangerous goods, risks of fire, explosion and pollution	**Very High (4)**
4	Terminals not inspected by authority	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	**High (3)**

Table 18: **Priority Areas for Floating Fuel Terminals, Cambodia (continued)**

No.	Possible Hazards	Possible Consequences	Priority Area
Infrastructure and Maintenance			
1	Operation in close proximity to small passenger vessels.	Increased risks of fire, explosion and property damage.	High (3)
2	Operation in close proximity to important wetlands and local communities	Increased risks to environment and local communities.	Very High (4)
3	No adequate berthing facility for Barge and/or small boats	Pollution, solid and liquid wastes disposed to the river.	High (3)
4	Petroleum storage tanks not inspected and maintained properly	Increased risks of spills, pollution and fire/ explosion.	High (3)
5	Fuel hoses and petroleum drum not maintained	Increased risks of spills, pollution and fire/ explosion.	High (3)
6	Terminal not maintained adequately	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	High (3)
Waste Management, Fire and Emergency Response			
1	No portable fire extinguishers available	Ineffective response to fires, increasing risks of explosion	High (3)
2	No firefighting pumps available.	Ineffective response to fires, increasing risks of explosion	High (3)
3	Not sufficient bunding around terminal.	Pollution, liquid wastes disposed to the river.	High (3)
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	High (3)
5	No waste reception facilities available.	Pollution, solid and liquid wastes disposed to the river.	Very High (4)

3.3.4 Viet Nam

In Viet Nam, the Ministry of Transport (MOT) is the highest government body responsible for overall maritime and IWT affairs in the whole country. It works through three executive agencies that are responsible for maritime and inland matters:

Vietnam National Maritime Bureau (VINAMARINE)

VINAMARINE is mainly responsible for all maritime matters concerning seaports and seagoing vessels. VINAMARINE implements all the international maritime safety conventions such as SOLAS, SAR, STCW, to which Viet Nam is a party. It organises examinations and issues certificates for seafarers and vessel officers. It also carries out maintenance and monitors vessel traffic regulations, surveys, inspections, pilotage, wrecks and salvage, procedures for transport of dangerous goods, certification of Vietnamese-flagged vessels and marine accident investigation.

Vietnam Register (VR)

VR is a specialist support unit that acts as a classification society; it classifies and issues technical certificates of seagoing vessels.

Vietnam Inland Waterways Administration (VIWA)

VIWA governs and maintains the inland ports, rivers, canals and navigable lakes of Viet Nam. VIWA implements the national safety regulations concerning river-going vessels on inland waterways, and monitors and maintains the safety of inland waterways; it also carries out controls, surveys, inspections and certification of these vessels/ports.

3.3.4.1 Legislation and Authority Control

According to answers to the questionnaires and research made, it can be concluded that the legislation related to ports and terminals along the Mekong River in Viet Nam is a complex system of legal documents issued by different state agencies. The Ministry of Transport (MOT) is mainly in charge of preparing national legislation for transport. Laws, ordinances and resolutions need to be submitted to the National Assembly for approval, and decrees need to be submitted to the Prime Minister for approval. MOT approves the circulars, joint circulars, regulations and decisions needed to be approved by the Ministry of Transport and other relevant ministries.

The *Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Vietnam on Waterway transportation* (Phnom Penh, 17 December 2009) contains several references concerning dangerous goods. These references are described in the legal chapter.

The main national laws that apply inland waterways are:

1. *Viet Nam Inland Waterway Law* 23/2004/QH11; and
2. *Decree No 21/2005/ND-CP* which regulates the implementation of this law.

Classification (inland or sea) of inland ports and terminals is regulated in *Decision 31/2004/QD-BGTVT*, dated 21 December 2004. This classification is based on the scale of the structure, size of the vessels that can be accommodated and the annual throughput. If the port/terminal is classified as an inland terminal the Viet Nam Inland Waterway Port Authority is responsible for port regulations and enforcement. The criteria for classifying either seaports, which are under the control of VINAMARINE, or river ports, which are under the control of VIWA, are complex and unclear so both types of ports coexist along the same stretch of river. On the same river waterway, there may exist two port authority systems, one under control of VINAMARINE and the other under control of VIWA. All inland ports in the Mekong Delta are state-owned or private companies.

The following decision/circulars apply for inland waterway ports and landing stations:

- *Decision No 27/2008/QD-BGTVT* (4 December 2008) regulates the responsibilities and authorities of VIWA;
- *Circular No 25/2010/TT-BGTVT* (31 August 2010) regulates the implementation of inland waterway ports and landing stages;
- *Circular No 34/2010/TT-BGTVT* (8 November 2010) regulates the operation of the Port Authority (port state control) systems; and
- *Circular No 101/2008/TT-BTC* (11 November 2008 regulates the implementation for fee, charge and fine collection of inland waterway ports and landing stages.

For inland ports and terminals, VIWA is responsible for implementing and ensuring compliance with

port laws, by-laws and regulations relating to the transport, handling and storage of dangerous goods and protection of the environment. Port operators are in charge for the safety and protection of the environment in ports and terminals.

Decree No. 29/2005/ND-CP of March 10, 2005 promulgating the list of dangerous goods and the inland waterborne transport thereof contains classification of dangerous goods, which is similar to the classification of dangerous goods by the International Maritime Dangerous Goods (IMDG) Code. The most important components are:

- Annex 1 of the decree which contains a list of dangerous goods;
- Chapter III, Article 8 which states that storekeepers and handlers of dangerous goods need to be trained under programmes set by the Ministry of Transport;
- Article 9 which states that the storekeeper has the overall responsibility for the loading/discharging and supervision of dangerous goods; and
- Section 1, Appendix 3 which describes sizes, signs and colours of dangerous goods symbols. Permits for transport, handling and storage are issued by the Ministry of Public Security for goods of Class 1,2,3,4 and 9, the Ministry of Science and Technology for goods of Class 5,7 and 8, the Ministry of Health for Class 6 goods and fertilisers for household use, and the Ministry of Natural Resources and Environment for other dangerous goods.

The Annex of *Circular MSC.1/Circ. 1301*, 9 February 2009, *Carriage of dangerous goods.* The IMDG Code contact information for the designated national competent authority. Section 7.9.3 of the IMDG Code identifies the main offices of the designated national competent authorities and bodies including:

- designated national competent authorities;
- competent authorities and bodies designated for the testing and certification of packagings, intermediate bulk containers (IBCs) and large packagings; and
- competent authorities and bodies which have been designated as competent inspection agencies or authorities for testing, approval, acceptance and other duties connected with portable tanks, road tank vehicles, multiple-element gas containers (MEGCs) and bulk containers (BK2).

These functions are dedicated to the Director General of VIWA and the International Relations Department is the focal point for further information. The Maritime Code of Vietnam has not yet fully adopted the IMDG Code, although this is planned for 2012. Considering the experience VIWA has with the IMDG Code, this would represent an excellent opportunity to expand and cover inland ports which receive both maritime and inland vessels.

Law on Fire Prevention and Firefighting, 2001

Firefighting equipment in ports and terminals is regulated by this law, and the following decrees relate to its implementation:

Decree No.35/2003/ND-CP (4 April 2003) details the implementation of some articles; and

Circular No. 04/2004/TT-BCA (31 March 2004) of the Ministry of Public Security guides the implementation of Decree No. 35/2003/ND-CP dated 04/04/2003 and stipulates that the Ministry is responsible for port/terminal fire protection.

Circular 14/2005/TTLT-BLDTBXH-BYT-TLDLDVN (8 March 2005) on recording and reporting labour accidents every six months by standard format.

The standards system in Viet Nam currently consists of over 6,000 national standards. The first of these

standards were developed in 1963. The directorate for Standards, Metrology and Quality (STAMEQ), of the Ministry of Science and Technology is the national standards body. The *Law on Standards and Technical Regulations* was adopted by the National Assembly in June 2006 and took effect on January 1 of 2007. Under this law, standards and technical regulations are simplified to three levels: national standards (TCVNs) and organisational standards (TCCSs), national technical regulations (QCVNs) and local technical regulations (QCDPS). Standards are applied voluntarily but technical regulations are mandatory.

Almost all technical standards regarding construction and equipment of terminals are according to Vietnamese technical standards (TCVN). These standards are developed on the basis of research results, the application of scientific and technological achievements, experience and the adoption of international standards relevant to the socio-economic conditions of Viet Nam[27]. These TCVNs are, however, applied voluntarily. There are currently no mandatory technical regulations (QCVNs) that apply for terminals.

3.3.4.2 Dangerous Goods Specifications

The following dangerous goods are transported stored and handled in Viet Nam: DO, KO, gasoline (M 92 & M95), LPG and fertilisers. The main functions of the terminals in the Mekong Delta are importing fuel and oil, and then supplying through commercial distribution networks. Fuel is imported from petroleum terminals in Ho Chi Minh City and most fuel products from the industrial zone at Dung Quat oil refinery (Quang Ngai province), either via Ho Chi Minh City or directly from Dung Quat.

3.3.4.3 Petroleum Terminals

The main terminals are located in Can Tho, My Tho and Tien Giang provinces. Quantities of dangerous goods handled at selected terminals are shown in the Table 19 below:

Table 19: **Petroleum Terminals and Throughput (million tonnes/year) in Mekong Delta**

No	Province and Port	Quay Length	Throughput (million tonnes/year)
1	PetroMekong	151m	0.45
2	CAWACO	210 m	0.6
3	Phuc Thanh Oil Co	41 m	0.1
4	Tra Noc Oil Co	45 m	0.1
5	Can Tho Oil Co	138 m	0.3
6	Hau Giang Oil Co	160 m	0.4
7	Tay Nam Bo Oil Co	80 m	0.2
8	Tra Noc Co	82 m	0.2
9	Cao Lanh Oil Co	90 m	0.4
10	Tay Nam Bo Oil Co	60 m	0.4

Information from these terminals was included in the project from Can Tho, My Tho and Dong Thap provinces. It is difficult to estimate the number of terminals operating as some are private terminals,

[27] Standards, regulatory reform and development in APEC: Case studies of Viet Nam and Thailand By Adam McCarty , National Economics University, Hanoi

floating terminals and some are registered with VIWA, VINAMARINE and provinces.

There are the two inland waterway port authorities in VIWA that are responsible for the control of fuel ports, ports and landing stages in the Mekong Delta in Viet Nam. Port Authority No 3 has control over 137 fuel ports and 676 ports and landing stages. Port Authority No 4 has control over 137 fuel ports and 1,426 ports and landing stages. The exact locations, type and quantity of dangerous goods and cargo throughput at the fuel ports is not known and requires further investigation.

To complete the risk assessment, four petroleum terminals were visited and inspected by the National Working Group by using the risk register:

1. **Tay Nam Bo Petroleum Terminal** is located at Tra Noc II Industrial Zone, Binh Thuy District, Can Tho City. Construction of the terminal was completed in 1998. It has 17 tanks for storing petroleum products and a total storage capacity of 99,300 m^3 (8 tanks of 3,000 m^3, 6 tanks of 12,500 m^3 and 3 tanks of 100 m^3). Petroleum products stored and handled at the terminal are DO, KO and Gasoline (M92 & M95). There are 50 employees of whom two are dedicated to administration. The terminal operator is the Tay Nam Bo Petroleum Co;

   The terminal has two jetties for supplying fuel. A small jetty discharges to vessels less than 60t and tankers between 60-1,000t, receiving up to 200 vessels a month. The other jetty is for receiving and discharging petroleum products to tankers greater than 1,000t and receives about 400 vessels annually. The terminal has a tow boat and oil spill response equipment for oil spills and fires. There appeared to be sufficient bunding to contain oil spills on the terminal jetty and pontoon. However, the boom was not in good working condition and needed replacing;

2. **Binh Duc Petroleum Terminal** is located in My Tho, Tien Giang province. The construction of the terminal was completed in 1997. It has 4 tanks for storing petroleum products and a total storage capacity of 5,700 m^3 (1 tank of 1,500 m^3, 3 tanks of 1,300 m^3 and 3 tanks of 100 m^3). Petroleum products stored and handled at the terminal are DO & Gasoline (M92). There are 40 employees of whom two are dedicated to administration. The terminal operator is Oil Tien Giang Co;

3. **Quang Trung Petroleum Terminal** is located in My Tho. The construction of the terminal was completed in 1997. It has 4 tanks for storing petroleum products and a total storage capacity of 4,000 m^3 (4 tanks of 1,000 m^3). Petroleum products stored and handled at the terminal are DO, KO and Gasoline (M92 & M95). There are 35 employees of whom two are dedicated for the administration. The terminal operator is Oil Tien Giang Co; and

4. **Dong Thap Petroleum Terminal** is located in Dong Thap. The construction of the terminal was completed in 2004. It has 6 tanks for storing petroleum products and a total storage capacity of 30,000 m^3 (6 tanks of 5,000 m^3). Petroleum products stored and handled at the terminal are DO, and Gasoline (M92 & M95). There are 40 employees of whom two are dedicated for the administration. The terminal operator is Oil & Gas Dong Thap Co.

3.3.4.4 Risk Evaluation for Ports, Terminals and Additional Operations

Upon completion of the risk assessment by the National Working Grouop, data and risk registers were analysed and used to compile a typical risk register. This typical risk register represents the current status of an average terminal in Viet Nam (Table 20).

Table 20: **Priority Areas for Viet Nam Terminals**

VIET NAM TERMINAL		
No.	**Hazard**	**Priority Area**
7708	No training on vessel waste management	4
1505	Maximum Allowable Pressure (MAWP exceeded)	3
1506	Safety devices not working (ex. Emergency Shutdown system not working)	
1507	Pressure gauges on cargo pipes not working	
1508	Safety systems manually by-passed	
1509	Lines not in use not properly blinded (flange connected with all bolts tight)	
1510	Gaskets, seals or flanges leaking	
1511	No colour coding on cargo pipes	
1514	Hot steam line not insulated	
1515	Construction material not corrosion resistant	
1517	Piping not properly supported	
1601	Cargo valves blocked	
1602	Cargo valves fail to operate	
1603	Cargo valve leaking	
1605	Emergency valves not readily accessible	
1606	Valves not fire rated	
1701	Warehouses/sheds not equipped with firefighting equipment	
1702	Segregation of DG not according regulations	
1901	No waste reception facilities available for vessels	
11001	Pump of fixed firefighting equipment not working	
11003	No international shore connection available	
11004	Fire hydrant blocked	
11005	Water spray curtain not working	
11006	Fixed firefighting pump capacity not sufficient	
11102	Portable firefighting equipment not regularly inspected/tested	
11201	Fire detection equipment not working	
11202	Fire detection equipment not regularly tested	
11501	No emergency equipment available	
11502	Emergency equipment not sufficient	
11505	No emergency control centre	
2201	Meters of tank wagons containing jet fuel or gasoline malfunctioning	
2202-2301	Leaking valves on tank wagons/trucks containing jet fuel or gasoline	
2203	Tank wagons containing jet fuel or gasoline: rupture of tank or welding seam	
2402	Walky Talkies not explosion proof	
2403	Communication with cargo control room not working	

Table 20: **Priority Areas for Viet Nam Terminals (continued)**

No.	Hazard	Priority Area
2501-2705	Emission of electric spark from trucks/trailers/generators	3
2704	Generator alarm/shutdown fails	
5201	Hot work permit not in use	
5202	Sparks from welding activities	
6301	New operating staff not properly trained	
6302	No procedures in place to ensure operators perform a task as required	
6303	No training for operators to complete task	
6304	Operator makes an incorrect reading	
6501	Accidents hazards not communicated	
6502	No records of accidents/Hazards	
6503	Accidents / hazards not reported	
6504	Language difference between terminal operator and vessel crew	
7201	Improper/inadequate inspections of terminal	
7301	No Authority control	
7401	Terminal has no policy, bad management	
7701	Terminal personnel not properly trained on handling DG	
7703-7704-7705	Training on firefighting equipment, emergency response procedures and accident prevention	
7706-7707	No training marine pollution prevention and environmental protection	
7709	No refreshment courses for personnel handling DG	
7801	No law enforcement	
7901	No regulations	
7902	Operator not aware of National regulation	
71003-71004-71005	No checklist regarding: bunkering, maintenance and safety items	
71202	No liquid waste management	
71301	No drug and alcohol policy	
8105-8107	Global events: typhoon, tsunami or tidal wave	
1101	Terminal close to residential area	2
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	
1103-1104	Open fire or hot works outside the terminal, close to tanks with DG	
1201	Access to terminal facilities uncontrolled, no surrounding walls, no fences, no controlled gates	
1301	Failing tank structure (ex. Tank supporting, corrosion, etc)	
1302	Bad welding seams on tank structure	
1403	Cargo pump leaking	
1404	No regular inspection of cargo pumps	
1501	Cargo transfer hose is ruptured	
1502	Cargo pipe fractured	
1503	Piping subject to surge pressure	
1504	Transfer hose leaking	

Table 20: **Priority Areas for Viet Nam Terminals (continued)**

No.	Hazard	Priority Area
1512	Pipe welding insufficient	2
1513	Piping located in areas with high vehicle traffic not separated from traffic flow by vehicle guards or beams	
1516	Piping specifications not followed	
1518	Corrosion rates not regularly checked	
1519	No flame arrestors on vent lines	
1520	Cargo pipes not regularly pressure tested	
1608	Valve indicator lights not working	
1609	Valve added to original system design, valves that are not on the original site plans	
1902	Capacity of waste reception facilities insufficient	
1903	Waste generated by port and cargo operations	
11002	Piping of fixed firefighting equipment not correctly aligned	
11101	No probable firefighting equipment stand-by	
11104	Portable firefighting equipment - Legal requirements not met	
11105	Incorrect firefighting equipment used	
11106	No fixed foam system	
11107	Firefighting equipment not working	
11401	No correct Personal protective equipment (PPE) provided	
11404	Safety showers not working	
11405	PPE not inspected at regular intervals	
11503	No spillage control equipment available	
11504	Spillage control equipment not sufficient	
2101	Tank high level alarm out of order	
2102	Tank high level alarm not calibrated	
2204	Meters on tank wagons containing diesel or IFO malfunctioning	
2205	Leaking valves on tank wagons containing diesel or IFO	
2206	Tank wagons containing diesel or IFO: rupture of tank or welding seam	
2302	Tank trucks containing jet fuel or gasoline: rupture of tank or welding seam	
2303	Malfunctioning of meters on tank trucks containing jet fuel or gasoline	
2304	Leaking valves on tank wagons containing diesel or IFO	
2401	No Walky - Talkies available	
3101-3102	High voltage cables in dangerous areas unprotected or badly insulated	
3201	Not enough clearance for overhead power lines	
3301	Electrical equipment and installations do not comply with the standards recognised by the competent authority	
3302	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	
3303	Electrical equipment and installations are not properly operated	
3304	Electrical equipment not properly earthed	
3401	Circuit breakers not adequate for circuit protection	

Table 20: **Priority Areas for Viet Nam Terminals (continued)**

No.	Hazard	Priority Area
3402	Circuit breakers not working	2
4104	No supervisions during cargo operations	
4201	Tank separation not to according standards (distance between storage tanks)	
4202	No or insufficient area to contain spills	
4203	Tank rupture due to internal corrosion	
6201	Operator does not understand/know the hazards of the process	
6202	No education corresponding to job requirements	
6305	Operator not provided with adequate supervision	
6402-6403-7701	No correct training course provided, no special training on handling DG	
6404	No refresher training on handling DG	
6405	No regular emergency drills conducted	
7102	Improper or inadequate procedures are in use	
7501	ISPS Code not in use/implemented	
7601	No measures in place to deal with DG spillage (Emergency Response Plan)	
7602	No emergency response drills	
7603	No or inadequate Emergency Response equipment	
7702	No training on first aid	
71001-71002	No checklist regarding Loading/discharging and transfer of cargo	
71101	No management system in use	
71102	No approved code of safe working practice available	
71103	No management concerning DG	
71201	No solid waste management (garbage, maintenance residues)	
8102-8103 8106-8108	Global events: lightning, mud slide, high winds and earthquake	

The National Working Group was granted access only to state-owned companies and these were included in the risk assessment. There are, however, many other privately-owned companies operating in the Mekong Delta that were not included in the Risk Analysis.

Additional Operations

During the site visits, a number of fixed and floating refuelling stations were observed in the Mekong Delta. In general, the floating fuel terminals under state-owned companies were in good condition. However, some of the private terminals had very limited controls (Table 21).

Table 21: **Priority Areas for Floating Fuel Stations, Viet Nam**

No.	Possible Hazards	Possible Consequences	Priority Area
Management, Authority and Control			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures.	**Very High (4)**
2	There are no rules and regulations for the safe operation of terminals	Unsafe operating conditions, increasing risks of incidents	**High (3)**
3	No management concerning dangerous goods	Limited awareness of dangerous goods, risks of fire, explosion and pollution	**Very High (4)**
4	Terminals not inspected by authority	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	High (3)
Infrastructure and Maintenance			
1	Operation in close proximity to small passenger vessels.	Increased risks of fire, explosion and property damage.	High (3)
2	Operation in close proximity to important wetlands and local communities	Increased risks to environment and local communities.	**Very High (4)**
3	No adequate berthing facility for Barge and/or small boats	Pollution, solid and liquid wastes disposed to the river.	**High (3)**
4	Petroleum storage tanks not inspected and maintained properly	Increased risks of spills, pollution and fire/ explosion.	**High (3)**
5	Fuel hoses and petroleum drum not maintained	Increased risks of spills, pollution and fire/ explosion.	**High (3)**
6	Terminal not maintained adequately	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	**High (3)**
No.	**Possible Hazards**	**Possible Consequences**	**Priority Area**
Waste Management, Fire and Emergency Response			
1	No portable fire extinguishers available	Ineffective response to fires, increasing risks of explosion	**High (3)**
2	No firefighting pumps available.	Ineffective response to fires, increasing risks of explosion	**High (3)**
3	Not sufficient bunding around terminal.	Pollution, liquid wastes disposed to the river.	**High (3)**
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	**High (3)**
5	No waste reception facilities available.	Pollution, solid and liquid wastes disposed to the river.	**Very High (4)**

The floating terminals require further investigation. In Tien Giang province, for example, the operation of floating fuel terminals has been prohibited due to concerns with safety and environmental protection.

Figure 40: **Floating Fuel Station in Mekong Delta, Viet Nam**

3.3.5 Thailand

3.3.5.1 Legislation and Authority

The main national legislation that applies for ports and terminals concerning handling and storage of dangerous goods on the Mekong River are:

- *Act on Navigation in Thai Water* (B.E. 2456 or 1913);
- *Marine Department Announcement 411/2542: Measures on Safety Discharge and Loading of Petroleum and Chemical Products;*
- *Marine Department Announcement 412/2542: Guidelines and Action Plan and Pollution Elimination for Handling Dangerous Goods in Port*; and
- *Safety Measures for Handling Petroleum Products on the Mekong River* (issued under the *Agreement on Commercial Navigation on the Lancang-Mekong River*).

The *Act on Navigation in Thai Water (*B.E. 2456 or 1913)[28]: may be one of the oldest Thai laws relating to navigation. As the act is an old law, it has been amended on several occasions and there are also many Ministerial Regulations and Announcements issued under the Act.

The *Thai Navigation Act* (Volume 14) as amended in 1992 prohibits dumping any refuse including oil and chemicals into rivers, canals, lakes and waterways that may pollute the environment or disrupt navigation on Thai waterways.

[28] Original name of the act was "the Act on Navigation in Siam Water B.E. 2456"

In 1974, the Thai government ratified the *Convention for the Safety of Life at Sea (SOLAS) 1974*. The Convention came into force in Thailand on 18 March 1975. As a result, in 1976, the Director General of the Harbour Department, with the approval of the Minister of Communication, issued the Harbour Department's *Announcement No. 353/2539* regarding the classification of dangerous goods and the IMDG Code was incorporated into the Act. We can conclude that Thailand is familiar with the classification of dangerous goods according the IMDG Code and with the IMDG Code in general.

The structure of the policy and institutional framework for the water and transport sector is relatively clear. Policy and planning comes from the Ministry of Transport (MOT) and the Office of Transport and Traffic Policy and Planning, while regulation is carried out by the Marine Department. Operators comprise both private companies and state-owned enterprises. The Marine Department and the Port Authority of Thailand (PAT), the regulators of the ports, are also responsible for the operation and development of major international ports, namely Bangkok Port, Laem Chabang Port and Ranong Port, and two regional ports on the Mekong River which are Chiang Saen Port and Chiang Khong Port. The PAT is the largest port operator in Thailand and falls under the supervision of the Ministry of Transport[29]. Compliance with rules and regulations is enforced by means of penalties such as fines, imprisonment or license withdrawal.

On 2 March 1991, an explosion caused by an unidentified chemical substance occurred in a dangerous goods warehouse in Bangkok. This explosion lead to the development of a safety system for the handling of dangerous goods. The incident prompted the PAT to emphasise the importance of proper handling of dangerous goods under a project that ran from 1991 to 1997. In March, 2003, the PAT joined a *Port Safety and Health and Environmental Management System* (PSHE-MS) project with support from the *Partnership in Environmental Management for the Seas of East Asia* (PEMSEA). In 2006, Bangkok Port received a recognition certificate for dangerous goods service from PEMSEA. In 2007, the project was extended to Leam Chabang Port which received its recognition certificate in 2009. For the regional ports, however, there is no progress yet.

In July, 2008, a project was developed for port waste management in Bangkok Port, Leam Chabang Port and Maptaphut Port[30]. Nothing is planned yet for ports and ferry crossings along the Mekong River.

The *Port Authority of Thailand* Act (B.E. 2494 or 1951), as amended in B.E. 2543 (2000), describes the work activities to be carried out by the PAT. These include management, monitoring and control of the five public ports under its supervision. The PAT is entitled to decide on appropriate management and operations of each port under is control (Table 22).

Table 22: **Responsibilities for Management of Ports in Thailand**

Agency	Policy	Regulation and Monitoring	Implementation
Ministry of Transport	X		
Office of Transport and Traffic Policy and Planning	X		
Marine Department		X	X
Port Authority of Thailand		X	X
Private Sector			X

The Government of Thailand has maintained a policy that allows the private sector to participate in

[29] Thailand Infrastructure Annual Report 2008

[30] Full report: http://www.md.go.th/safety_environment/04_3_pdf/PDF-Exe/Executive-Eng.pdf

port services, either by operating existing facilities or by funding the development of new or additional facilities and operating them. Before private operators can commence, they need the following permits issued by the competent authorities:

- Berth Construction Permit issued by the Marine Department before constructing the port according to the Navigation in *Thai Water Act* (B.E. 2456);
- Berth Inspection Permit issued by the Marine Department before the port is commissioned according the Navigation in *Thai Water Act (*B.E. 2456);
- Port Business Permit issued by the MOT through the Marine Department under National Executive Council N. 58 concerning Business Affecting Public Security and Well-Being;
- Ministerial Regulation, Specification of Occupational Safety, Hygiene and Environment Management Standards (B.E. 2549)[31].

Rules issued under Sections 6 and 103 of the *Labour Protection Act* (B.E. 2541 or 1988) regulate employers' occupational safety and health obligations. The Act applies to mineral and rock mines, petroleum and petrochemical businesses, manufacturing, construction, hotels etc (Section 1). The four chapters cover legal definitions (Section 2), the establishment of safety manuals (Sections 3-4), training of workers (Sections 5-6), appointment of OSH delegates (Sections 7-18), establishment of OSH committees (Sections 23-35) and OSH reports and notifications (Sections 33-41).

Chapter 8 of the *Labour Protection Act* (B.E. 2541 or 1988)[32] concerns occupational safety and health, creates Work Safety, Occupational Hygiene and Environmental Conditions Committees and provides for labour inspection.

The *Notification of the Ministry of Labour and Social Welfare Regrading Working Safety of Employees* applies to workers in the mining, energy, petroleum, water, construction and transportation sectors. It provides for the appointment of a safety official at the shop, foreman, and executive level in enterprises with less than 50 employees. In enterprises with more than 50 employees, there shall be a professional safety officer as a full-time position.

The *Notification of Ministry of Labour and Social Welfare: The Committee for Safety, Occupational Health, and Surrounding Condition in Work Performance*[33] covers employers with fifty or more employees. They are required to establish a Committee for Safety, Occupational Health, and Surrounding Conditions of Work Performance, whose duties include making recommendations and reports on safety conditions at the workplace. The Committee shall include employees or employee representatives, meet at least once a month, and employee participants shall be paid regular wages for work done in relation to the Committee.

Notification of the Ministry of Industry No. 25 (B.E. 2531) issued pursuant to the *Provisions in the Factories Act* (B.E. 2512[34]) replaces Clause 20 and accompanying schedules in Notification of the Ministry of Industry No. 2 (B.E. 2513) of 1970 in regard to the duties of recipients of a factory operating licence. It deals with storage and disposal of hazardous materials in accordance with guidelines prescribed by the Industrial Factories Department.

Other instruments relating to occupational safety and health are:

Ministerial Regulation, Specification of Occupation Safety, Hygiene and Environment Management Standards (B.E. 2549)

[31] Official Gazette, 2006-06, Volume 60, No. 6, pp. 279-294

[32] Government Gazette (English translation), 1998-03, Vol. 52, No. 3, p.43

[33] Royal Thai Government Gazette (Translation), 1995-09, Vol. 49, No. 17, pp. 339-346

[34] English version in Royal Thai Government Gazette, 1988-09-30, Vol. 42, No. 27, p. 269-279

Ministerial Regulation on Administration and Management of the Aspect of Occupational Safety and Health and Working Environment relating to Machines, Cranes and Boilers (B.E. 2552).[35]

Ministerial Regulation Specifying Factory Electrical System Safety Measures (B.E. 2550) issued under the *Factory Act* (B.E. 2535)[36] regulates electrical safety, including inspection of electrical installations.

The *Hazardous Substance Act* (B.E. 2535) of 29 March 1992 contains provisions on the control of hazardous substances, duties and civil liabilities, and penalties.[37]

Notification of the Ministry of Interior regards safety in connection with electricity.[38] Chapter VII, governs personal protective equipment.

The *Enhancement and Conservation of the National Environmental Quality Act* (B.E. 2535 or 1992);

Public Health Act (B.E. 2535) regulates nuisance activities related to water pollution such as odour, chemical fumes, wastewater discharge systems of buildings, factories or animal feedlots that cause harmful health effects.

3.3.5.2 Dangerous Goods Specifications

According to the questionnaires, the different kinds of dangerous goods stored and handled on the Mekong River are petroleum products such as gasoline, diesel, asphalt and fertiliser. These are mainly intended for Thai and Lao domestic consumption. The dangerous goods are primarily carried by tanker trucks and truck trailers onboard ferries between Thailand and Lao PDR.

3.3.5.3 Main Ports and Terminals

There are two main port/terminals in Thailand:

Chiang Saen Port:

Located on the bank of the Mekong River, Chiang Saen district, Chiang Rai Province (Figure 41), this port serves as the main gateway for transporting goods from the Greater Mekong Sub-region (GMS), especially southern China which uses it as a mid-point depot prior to export through Laem Chabang Port. As a result of the GMS Economic Cooperation Agreement signed by six countries (Cambodia, China, Lao PDR, Myanmar, Thailand and Viet Nam), Chiang Saen Port has gained strategic importance as an optional transportation route. This applies particularly to China which has a huge production capacity and an enormous consumer market.

Figure 41: **Aerial View of Chiang Saen Port**

[35] Royal Thai Government Gazette, 2009-09, Vol. 63, No. 9, pp. 459-501

[36] Royal Thai Government Gazette (International Translations Office), 2007-08, Vol. 61, No. 8, pp. 425-428

[37] Unofficial English Translation: http://www.diw.go.th/law/hazae.html

[38] Labour Laws (revised 1985), p. 168-207

Chiang Saen Port officially opened in 2003. The port has two pontoons with bridges that link with the quayside and can accommodate 8-10 freighters. Trucks can load and transfer cargo on the vessels at all times. The port has a parking area for 50 trucks and is equipped with one mobile crane (capacity 50 tonnes) and a conveyor belt (Figure 42). The main dangerous goods handled are Diesel and MOGAS (IMDG Class 3) and fireworks (IMDG Class 1). The oil tankers calling at Chiang Saen Port are from China, Lao PDR and Myanmar. The gross tonnage of these tankers ranges from 80 to 200 tonnes. The quantity of fuel exploitation at Keawalee Terminal is shown in Table 23 below.

Figure 42: **Chiang Saen Port**

Table 23: **Quantities of Fuel Exploitation at Keawalee Terminal, Thailand**

Dangerous Good Type	Quantities Of Fuel Oil Exportation In Litres				
	2006	2007	2008	2009	2010
Diesel & MOGAS (IMDG Class 3)	5,189,000	6,692,000	7,907,000	11,184	12,449
Fireworks (IMDG Class 1)	-	-	-	1,039 tonnes	3,160 tonnes

A new port is being built in Chiang Saen. Known as Chiang Saen II, it is located about 10 km south of the first port and is expected to contribute greatly to Thailand's logistics development. It was reported by the MOT that the first Chiang Saen Port had become too small to accommodate the rapid growth of trade and transportation between Thailand and China. The expansion of the first port is not allowed, since it is located within a designated historical area being preserved as a part of national heritage. Moreover, the Treasury Department is developing this area to be registered as a World Cultural Heritage Site. The historical site will also be promoted as a major tourist destination in northern Thailand. The main objective of developing the new port will be to promote Thailand as the centre of trade, investment and transport in the Upper Mekong region, linking with southern China. The new port of Chiang Saen will also help develop Chiang Rai into a major gateway between Thailand and southern

China that will serve as a factor to bring about development on a continual basis. With railway development to this gateway and port development in the Andaman Sea, Thailand will be able to provide a multimodal transport corridor and open up a new trade lane, linking with southern China, India, the Middle East, Africa and Europe.[39]

The construction of Chiang Saen Port II started in 2008 and was scheduled to be completed in mid-2012. The port is designed as a multipurpose port with storage areas for general cargo, a container yard and a tank farm with an adjacent tanker berth. In the future, the People's Republic of China intends to import 150,000 m^3 of fuel through the new port. The port will be able to accommodate simultaneously ten 50-metre vessels (500 DWT). Its total area will be 640,000 square metres, which is about 40 times bigger than the first port. Chiang Saen Port II will consist of:

- 6 berths loaded by manpower;
- 9 berths loaded by conveyer belt;
- 6 container terminals;
- 1 petroleum berth and
- 6 passenger berths.

Figure 43: **Chiang Saen Port II**

[39] Government Public Relations Department: http://thailand.prd.go.th/view_inside.php?id=2488

Keawalee Pier

- At Keawalee Pier, most operations consist of fuel transfer from trucks to vessels (Figures 44):

Figure 44: **Fuel Transfer from Truck to Vessel at Keawalee Pier**

Chiang Khong Port

Chiang Khong Port is a small river port located on the bank of the Mekong River in Chiang Khong district, Chiang Rai Province. The port is a one berth port opposite Muang Huay Xay, Bor Kaew district, Lao PDR. Behind the port is a road linking Chiang Khong with Chiang Saen district. The port is an important passenger port transporting numerous passengers and cargo loaded on vehicles between Chiang Khong and Hua Xay (Figures 45 and 46). The ferries are mainly used to carry fuel trucks, construction materials and consumables between Thailand and Lao PDR. The berth is 24 metres wide and 180 metres long. The port operator is the Port Authority of Thailand (PAT).

Figure 45: **Chiang Khong Port**

Figure 46: **Chiang Khong Port – Fuel Trucks Boarding A Ferry**

There are numerous ferry crossings between Thailand and Lao PDR along the Mekong River, the main ferry crossings included in this study are located in Chiang Khong, Bungkham and Mukdahan (Figure 47).

Figure 47: **Typical Ferry Readies for Landing in Thailand**

3.3.5.4 Risk Evaluation for Ports, Terminals and Additional Operations

In order to complete the risk assessment two ports were visited and inspected by the National Working Group by using the risk register (Table 24):

- Chiang Saen Port; and
- Keawalee Terminal.

Table 24: **Priority Areas for Inland Ports, Thailand**

THAILAND PORT		
No.	**Hazard**	**Priority Area**
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	4
1301-4201-4501	No designated storage area for DG	
1302	No register of DG and no Material Safety Data Sheets (MSDS) available	
1401	No waste reception facilities for ferries	
1402	Waste generated by trucks and port operations not collected	
1501	No fixed fire pump available or fire pump not working	
1502	No fire hoses available	
1503	No fire hydrants or fire hydrants no accessible	
1601	No portable fire extinguishers available at the port or on the ferry	
1602	Portable fire extinguishers not regularly inspected or tested	
1603	Limited type of fire extinguishers available (Water, CO2, dry powder, foam)	
1701	No correct PPE provided (hard hats, high-vis clothing, eyewear, etc)	
1702	Life saving equipment (lifebuoys and life jackets) not available on ferry/ port	
1801	No emergency equipment available	
1802	No oil spill response equipment available onboard ferry or at ferry site)	
3101	High voltage cables in port/ferry site are unprotected or not insulated	
3201	Not enough clearance for overhead power lines	
4402	Trucks not inspected effectively to determine if DG carried are in good condition, have the correct MSDS and correct safety and fire equipment	
4502	No proper containers used to store DG, containers labelled incorrectly	
4503	No dangerous goods register available or no MSDS at the port or on the ferry	
4601	No proper working language, signs or symbols	
5201	Hot work permit not used for welding, cutting in port or on ferry	
5202	No control of welding operations in port areas or on ferry	
6101	New operating staff not properly familiarised / trained	
6102	No procedures in place for ferry operations (loading ferry, navigation, etc)	
6201	No training for port or ferry operators	

Table 24: **Priority Areas for Inland Ports, Thailand (continued)**

No.	Hazard	Priority Area
6202	Special training for handling DG not provided	4
6203	No regular emergency drills conducted	
6302	Accidents/hazards not reported	
7101	No or limited safety procedures for the ferry crossing operations to prevent accidents and pollution	
7102	Improper or inadequate procedures are in use	
7501	No measures in place to deal with DG spillage (Emergency Response Plan)	
7502	No emergency / Live Saving response drill	
7602-7603-7604-7605-7606	No training on: Emergency/firefighting equipment, Safe navigation/ ferry operations, accident prevention, environmental protection, waste management (port/ferry)	
8101-8105	Global events: flooding and typhoon	
91	Local fuel transfer not regulated by authorities	
92	No safety procedures for local fuel transfer	
93	Fuel hoses and drums for local fuel transfer not maintained	
94	No adequate equipment available to contain spills	
95	No waste reception facilities at local fuel transfer site	
1101	Port close to residential area	3
2101-2102	No process to inspect Tank trucks containing diesel, IFO, gasoline or LPG before boarding ferry	
2201-2202-2203	No process to inspect ordinary trucks/trailers carrying DG	
2401	The port has no emergency generator	
3202	Mechanical damage to cables	
3301	Electrical equipment/installations not regularly inspected and in poor condition	
4101-4301	No procedures for loading of trucks carrying DG in bulk	
4102	No communication between port and ferry during loading of trucks carrying DG	
4401	No procedures for loading of trucks carrying packaged DG	
5101	Terminal/port equipment not regularly inspected and maintained	
5102	No maintenance schedule for maintenance at the port/ferry	
6301	No records of accidents/hazards	
7201	Improper/inadequate inspections of ferry crossing operations	
7301	No regulations for ferry crossing operations	
7302	Operator not aware of National Regulations	
7601	No training on first aid	
7607	Operator not aware of National Regulations	
7701	No checklist for loading/unloading ferry	
7702-7703	No checklist to inspect trucks carrying DG and loading fuel to ferry	
7704-7705	No checklist for maintenance of the port/ferry, safe navigation/ferry operations	
8104-8106-8107	Global events: heavy and prolonged rain storms, high winds and Tsunami or tidal wave	

Table 24: **Priority Areas for Inland Ports, Thailand (continued)**

No.	Hazard	Priority Area
1201	Access to the port uncontrolled, no surrounding wall, no fence, no controlled gate	2
2301	No VHF radios or communication available	
2302	No communication between port and ferry	
2304	No communication between left and right bank (ports)	
7401	No security or customs procedures in place to prevent unauthorised access	
7801	No solid waste management (garbage and maintenance residues)	
7802	No liquid waste management (oily water) from the ferries	
7901	No drug and alcohol policy	
8103-8108	Global events: mud slide and earthquake	

3.3.6 Lao PDR

3.3.6.1 Legislation and Authority

The national legislation regarding the storage and handling of dangerous goods is prepared by the Department of Waterways, Ministry of Public Works and Transport and the department of PWT province. The main existing legislation:

- *Draft Rule on Safety of the Port;*
- *Draft Rule on Dry Port;*
- *Draft Regulation on Handling and Storage of Dangerous Goods;* and
- *Draft Rule on Inland Waterway Transportation of Dangerous Goods.*

These documents are however only available in Lao at this stage.

MPWT is responsible for the import/export and the Ministry of Natural Resources and Environment (MONRE) for the storage and handling of dangerous goods, including EIA process. The Boats Association and the provincial PWT departments are responsible for implementing and ensuring compliance with port laws, by-laws and regulations relating to the storage and handling of dangerous goods in port areas.

Operators of ports and petroleum terminals are required to submit an environmental management plan to the Government. The requirements for a private operator to install a fixed or floating refuelling station or small petroleum terminal on the Mekong River follow the *Decree on Measurement Management No: 163/PM,* 26 October 1993.

Ports and Petroleum terminals are required to submit an emergency response plan to the Prime Minister's Office, Ministry of Public Work and Transport, Ministry of Finance, Ministry of Public Security, Ministry of Public Health, Ministry of Agriculture and Forestry and the Lao National Mekong Committee.

3.3.6.2 Dangerous Goods Specifications

Petroleum products, gasoline and diesel, together with toxic chemicals such as mercury and sodium cyanide used for gold mining, are the principal dangerous goods transported, handled and stored. Other commodities stored and handled are logs, cement, rice, concrete pipes, construction materials, timber and agricultural products. The illegal transport of fertilisers, herbicides and pesticides across the Mekong River from Thailand to Lao PDR needs further investigation.

3.3.6.3 Main Ports and Terminals

Km 4 State Port

Km 4 State port is located in Vientiane Capital and is managed by the Ministry of Public Works and Transport (MPWT) (Figure 48). The 29 employees are responsible for coordinating port operations, customs, security and forestry. Cargo exports have, however, decreased due as transport companies have opted for improved roads as a more viable and reliable transport link. However, the Mekong River still provides an important transport link between rural provinces in Lao PDR and the capital. The main types of cargo handled are construction materials, agricultural products and timber. Km 4 Port has two underground storage tanks on the premises, each having a storage capacity of 10,000 litres. These tanks are filled by fuel trucks which are responsible for testing the integrity of the fuel tanks prior to loading. The tanks in the port were flooded by Mekong waters in 2008, when management had the lids opened to check the condition of the tanks and their contents. On that occasion some 20 m^3 of diesel were spilled into the Mekong.

Figure 48: **Km 4 State Port**

3.3.6.4 Risk Evaluation for Ports, Terminals and Additional Operations

The Lao Port Priority Areas is a combination of risk registers from Km 4 State Port, Luang Prabang Cargo and Passenger Ports, Nakasan Passenger Port and Huay Xay, Ban Thuya and Pakxanh Ferry Crossings (Table 25).

Table 25: **Priority Areas for Inland Ports, Lao PDR**

LAO PDR PORTS		
No.	**Hazard**	**Priority Area**
1101	Port close to residential area	4
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	
1301-4201-4501	No designated storage area for DG	
1302	No register of DG and no Material Safety Data Sheets (MSDS) available	
1401	No waste reception facilities for ferries	
1402	Waste generated by trucks and port operations not collected	
1501	No fixed fire pump available or fire pump not working	
1502	No fire hoses available	
1503	No fire hydrants or fire hydrants no accessible	
1601	No portable fire extinghuishers available at the port or on the ferry	
1602	Portable fire extinghuishers not regularly inspected or tested	
1603	Limited type of fire extinghuishers available (Water, CO2, dry powder, foam)	
1701	No correct PPE provided (hard hats, high-vis clothing, eyewear, etc)	
1702	Life saving equipment (lifebuoys and life jackets) not available on ferry/port	
1801	No emergency equipment available	
1802	No oil spill response equipment available onboard ferry or at ferry site)	
3201	Not enough clearance for overhead power lines	
4402	Trucks not inspected effectively to determine if DG carried are in good condition, have the correct MSDS and correct safety and fire equipment	
4502	No proper containers used to store DG, containers labelled incorrectly	
4503	No dangerous goods register available or no MSDS at the port or on the ferry	
4601	No proper working language, signs or symbols	
5201	Hot work permit not used for welding, cutting in port or on ferry	
5202	No control of welding operations in port areas or on ferry	
6202	Special training for handling DG not provided	
6301	No records of accidents/hazards	
6302	Accidents/hazards not reported	
7101	No or limited safety procedures for the ferry crossing operations to prevent accidents and pollution	
7201	Improper/inadequate inspections of ferry crossing operations	
7301	No regulations for ferry crossing operations	
7302	Operator not aware of National Regulations	

Table 25: **Priority Areas for Inland Ports, Lao PDR (continued)**

No.	Hazard	Priority Area
7501	No measures in place to deal with DG spillage (Emergency Response Plan)	4
7502	No emergency / Live Saving response drill	
7602-7603 7604-7605-7606	No training on: Emergency/firefighting equipment, Safe navigation/ ferry operations, accident prevention, environmental protection, waste management (port/ferry)	
7607	Operator not aware of National Regulations	
7702-7703	No checklist to inspect trucks carrying DG and loading fuel to ferry	
7802	No liquid waste management (oily water) from the ferries	
8105	Global events: typhoon	
9102	Storage area is open and no infrastructure for storage	
9104	The port is used for a long tile without maintenance	
2101-2102	No process to inspect Tank trucks containing diesel, IFO, gasoline or LPG before boarding ferry	3
2201-2202-2203	No process to inspect ordinary trucks/trailers carrying DG	
4101-4301	No procedures for loading of trucks carrying DG in bulk	
4401	No procedures for loading of trucks carrying packaged DG	
5101	Terminal/port equipment not regularly inspected and maintained	
5102	No maintenance schedule for maintenance at the port/ferry	
6101	New operating staff not properly familiarised / trained	
6102	No procedures in place for ferry operations (loading ferry, navigation, etc)	
6203	No regular emergency drills conducted	
7102	Improper or inadequate procedures are in use	
7704-7705	No checklist for maintenance of the port/ferry, safe navigation/ferry operations	
7801	No solid waste management (garbage and maintenance residues)	
8104-8106	Global events: heavy and prolonged rain storms and high winds	
9101	Runway to and from the port is small and steep	
9103	Soil erosion from the slope of the bank and impact on infrastructure	
1201	Access to the port uncontrolled, no surrounding wall, no fence, no controlled gate	2
3101	High voltage cables in port/ferry site are unprotected or not insulated	
3202	Mechanical damage to cables	
4102	No communication between port and ferry during loading of trucks carrying DG	
6201	No training for port or ferry operators	
7401	No security or customs procedures in place to prevent unauthorised access	
7601	No training on first aid	
7701	No checklist for loading/unloading ferry	
7901	No drug and alcohol policy	
8101-8103-8108	Global events: flooding, mud slide and earthquake	

3.4 INTERMEDIATE REGIONAL AND NATIONAL CONCLUSIONS

3.4.1 Introduction

The Mekong River is the heart and soul of mainland Southeast Asia. More than 60 million people depend on the Mekong as a source of fish (the river supports one of the world's most diverse fisheries, second only to Brazil's Amazon River) and other aquatic products for food and income, water to grow crops and as a transport route which provides access to markets. The multitude of ecosystems within the Mekong River Basin supports a huge diversity of plants and animals, with new species still being discovered.

The rapid economic and demographic growth, emerging industrialisation, urbanisation and infrastructure development of the countries along the Mekong River are increasing stress on natural resources, the environment and water quality. Associated problems such as increased solid waste production, sewage and increased industrial wastewater disposed of with no or limited treatment are the major sources of increased stress. Additional stress caused by accidents/incidents at terminals handling or storing dangerous goods should be avoided. Large spills of petroleum products cause environmental damage, and an inevitable loss of aquatic resources with serious economic repercussions.

While the adverse effects of oil spills on the natural environment are widely recognised among the riparian countries and immediately apparent as they are visible, the sustained release of smaller - often visually undetectable - amounts of oil from terminals can be just as damaging. The carriage, handling and storage of dangerous goods are activities that are potentially dangerous for people, property and the environment if not carefully handled and regulated. During the risk assessment, the main risks concerning dangerous goods were considered regarding their potential effects on populations, property and the environment.

The eventual goal will be to find a way to manage the carriage, handling and storage of dangerous goods so that benefits are optimal and eventual risks are reduced to an acceptable level and, if an accident/incident occurs, that well-prepared emergency plans are in place to reduce the impact on people, property and the environment.

3.4.2 Petroleum Terminals

A study of major storage tank accidents[40] reviews 242 accidents at storage tanks in industrial facilities in North America, Asia, Australia, Europe, South America and Africa over a period of 40 years (Table 26). These accidents have occurred in:

- petroleum refineries;
- terminals and pumping stations;
- petrochemical plants;
- oil fields; and
- other types of industrial facilities such as power plants, gas plants, pipelines, fertiliser plants, etc.

The study is based on reviews of published accidents so the results depend on the accessibility of accident information. The results of the study are based on major accidents/incidents only. Minor accidents involving pollution or a few injuries are not included in the study.

[40] Journal of loss Prevention in the process industries, A study of storage tank accidents, James I. Chang, Cheng-Chung Lin

Table 26: **Types of Facilities Where Accidents Occurred**

Year	Refinery	Terminal/ Storage	Chemical Plant	Oil Field	Misc.	TOTAL
1960-1969	10	5	1	0	1	**17**
1970-1979	22	11	0	0	3	**36**
1980-1989	25	17	5	2	4	**53**
1990-1999	41	22	16	1	5	**85**
2000-2003	18	9	9	3	12	**51**
TOTAL	**116**	**64**	**31**	**6**	**25**	**242**

3.4.2.1 Types of Accidents

Crude oil, gasoline and oil products such as fuel oil and diesel were the major products involved in these accidents. Fire was the most frequent type of loss with 145 cases followed by explosions with 61 cases. Fires and explosions together accounted for 85 percent of the accidents. Oil spills were the third most frequent type of loss followed by releases of toxic gas/liquids. The table below indicates an overview of the different types of accidents (Table 27).

Table 27: **Types of Accidents**

Year	Fire	Explosion	Spill	Toxic Gas	Misc	TOTAL
1960-1969	8	8	0	0	1	**17**
1970-1979	26	5	5	0	0	**36**
1980-1989	31	16	3	2	1	**53**
1990-1999	59	22	2	1	1	**85**
2000-2003	21	10	8	10	2	**51**
TOTAL	**145**	**61**	**18**	**13**	**5**	**242**

3.4.2.2 Cause of Accidents

The most frequent causes of accidents were lightning, maintenance error/hotwork, operational error, equipment failure, sabotage, crack and rupture, leak and line rupture, static electricity, open flames and natural disasters. The table below indicates an overview of the main causes of tank accidents (Table 28).

Table 28: **Causes of Tank Accidents**

Cause	1960-1969	1970-1979	1980-1989	1990-1999	2000-2003	TOTAL
Lightning	4	10	19	37	10	**80**
Maintenance/hot work	1	5	9	12	5	**32**
Operational error	1	5	6	8	9	**29**
Equipment failure	3	1	5	7	3	**19**
Sabotage	2	5	2	6	3	**18**
Crack/rupture	0	3	3	3	8	**17**
Leaks and line rupture	0	3	2	5	5	**15**
Static electricity	2	1	2	2	5	**12**
Open flame	1	0	4	2	1	**8**
Nature disaster	1	2	1	1	2	**7**
Runaway reaction	2	1	0	2	0	**5**
Total	**17**	**36**	**53**	**85**	**51**	**242**

3.4.2.3 Ten Largest Tank Accidents Between 1963 and 2002

The table below gives on overview of the ten largest tank accidents between 1963 and 2002, illustrating the total economic loss and a small description of the cause (Table 29).

Table 29: **Ten Largest Tank Accidents**

Country	Year	Cause	Description	Loss ($ million)
Greece	1986	Maintenance error	Sparks from a flame-cutting torch ignited fuel from a tank spill in a dike of a fuel oil tank. The fire spread to other areas resulting in the destruction of 10 out of 12 tanks.	330
Qatar	1977	Leak and line rupture	A 260,000-barrel tank containing 236,000 barrels of refrigerated propane at -45° C failed. An adjoining refrigerated butane tank and most of the process area were also destroyed by fire.	179
Netherlands	1968	Runaway reaction	Frothing occurred when hot oil and water emulsion in a slop tank reacted with volatile slop, causing a violent vapour release and boil-over. The fire destroyed 3 hydrocarbon plants, a sulphur plant and 80 tanks.	141
USA	1979	Lightning	Nearly simultaneous explosions during a electrical storm occurred aboard a 70,000 DWT tanker that was offloading and at an 80,000 barrel ethanol facility at a refinery.	138
USA	1978	Unknown	Unidentified failure led to the release of light hydrocarbons which spread to an ignition source. Eleven tanks in this alkylation unit were destroyed.	120
Kuwait	1981	Open Flame	Fire destroyed 8 tanks and damaged several others. The cause of the fire was not disclosed.	73

Table 29: **Ten Largest Tank Accidents (continued)**

Country	Year	Cause	Description	Loss ($ million)
Kuwait	1981	Open Flame	Fire destroyed 8 tanks and damaged several others. The cause of the fire has not been disclosed	73
India	1997	Leak and line rupture	LPG ignited during tank loading for a vessel. A thick blanket of smoke spread panic among residents, resulting in 37 deaths and 100 people injured. Fifteen storage tanks burned for two days.	64
Italy	1985		Twenty-four of 32 tanks at a marine petroleum products terminal were destroyed by a fire that began with a tank overfill. Explosion caused destruction of the terminal buildings and nearby industrial and residential structures.	60
USA	1983	Operational error	An overfilling of a floating-roof tank spilled 1,300 barrels of gasoline into a tank dike. The vapour cloud was carried by wind to a nearby incinerator and ignited. The resulting explosion destroyed two adjacent tanks and the terminal.	52
USA	1983		A low pressure LNG feed drum ruptured in a crude oil station, resulting in fire damage to one third of the module and exterior of surrounding structure within 100 feet.	47
Average property loss in millions of 2002 dollars				

3.4.2.4 Example of a Recent Accident and Related Costs

At the Buncefied Fuel Depot of Britain's Hertfordshire Oil Storage Terminal, a tank overfilled due to instrumentation failure in December, 2005. A high-level gauge had failed to show that the tank was full. The devastation at Buncefield was estimated in excess of $16 million in stored material alone, in addition to the destruction of the site itself and the effect on the surrounding business. Forty-three people were injured. At least 20 businesses at a nearby industrial estate housing 630 businesses lost their premises, affecting the livelihoods of some 500 people (Buncefield Investigation 2006) (Figure 49).

Figure 49: **Buncefield Accident**[39]

The total quantifiable economic cost of the Buncefield incident was estimated at £894 million ($1.8 billion), excluding the cost of site rebuilding. The table below gives a summary of the overall cost of the Buncefield incident, by main category:

[39] http://www.cjwalsh.ie/2011/10/23/

Table 30: **Summary of the Overall Cost of the Buncefield Incident**[41]

Sector	Total Cost	
	GBP (£) million	USD ($) million*
Site operators (compensation claims)	625	1,227
Aviation	245	481
Competent Authority and Government response	15	29
Emergency response	7	14
Environmental impact (drinking water)	2	4
Total	**894**	**1,755**

* Based on the exchange rate December 2006 : £ 1 = $1.96258

The conclusions of the paper are that the causes and the contributing failures that led to these accidents would have been avoided if good engineering in design, construction, maintenance and operation had been practised with the implementation and execution of a safety management programme.

Eliminating all hazards will never be possible as there will always be contributing factors that cannot be ruled out and others that are either unpredictable or uncontrollable. The risk of accidents can, however, be significantly reduced if the regulatory authority establishes minimum standards for compliance for design, construction, maintenance, operations and safe management of terminals. In the event of an incident, an organised and effective response to an emergency can be achieved. It is then the responsibility of terminal management to meet or exceed these standards and be able to respond effectively in case an emergency occurs.

3.4.3 Ports

In ports where packaged dangerous goods in containers are handled or stored, the following primary activities take place:

- unloading/loading of these containers from vessels via forklifts, reach stackers and/or cranes to/from the storage stacks;
- loading/unloading of container trucks via forklifts and/or reach stackers to/from the storage stacks;
- storage of containers in the stack waiting for export/import;
- on-site transportation of these containers;
- storage and handling of packaged dangerous goods in warehouses; and
- storage of diesel fuel for on-site vehicle use.

In general, with these primary activities on the site, the following four major hazards can be associated:

1. Damage to containers and potential loss of containment caused by dropping or impact of a container on a solid object during a lift.
2. Damage to containers and potential loss of containment caused by a vehicle accident on or off-site.

[41] The Buncefield incident 11 December 2005, The final report of the major incident investigation board, Volume1

3. A “spontaneous” leak occurring from containers during storage of the container on-site.
4. Loss of containment from a diesel fuel tank resulting in a pool fire.

These incidents can escalate in the event that a fire occurs on-site.

Each accident/incident mentioned above can have disastrous consequences: pollution, injury or death and damage or loss of assets. Additionally, these accidents can represent a sustainable cost for the port/ terminal operator. Costs for the port terminal operator can included but are not limited to:

- disruption of cargo operations;
- administrative work;
- compensation for the individual, the cargo/transport owner;
- repair costs;
- increased insurance costs; and
- damage to the reputation of the port/terminal.

The consequences of an incident at a port where dangerous goods in containers are handled/stored will normally be inferior to an accident at a terminal where large quantities of liquid dangerous goods in bulk are handled/stored. The consequences of these incidents will be reduced if proper emergency planning is in place.

3.4.4 Risk Analysis of Ports and Terminals

The main objective of the risk analysis of the carriage, handling and storage of dangerous goods along the Mekong River is to control and manage the risks associated with the storage and handling of dangerous goods. Controlling and managing these risks will result in a reduction of pollution, injury or death of people and damage or loss of assets. A detailed risk register was drafted containing a number of hazards divided into nine groups. Sample ports/terminals were selected in coordination with the respective National Working Groups. For Cambodia, three terminals handling petroleum products in bulk and one port was selected. For Viet Nam, three terminals handling liquid petroleum products in bulk were selected

Upon completion of the risk register, the risk level and the existing control measure(s) were used to determine a priority area. This priority area has a scale from 0 to 4 with 4 being Very High. The terminal with limited controls is a combination of different terminals. It provides an idea of the worst case scenario and does not reflect in any way the risks at one particular terminal.

3.4.4.1 General Observations

- Terminals handling petroleum products in bulk with high standards assigned a higher risk priority level for the same hazard than petroleum terminals with lower standards. The reason for this is that terminals with high standards have a better understanding of the principles of risk assessment and have a better appreciation of the associated risks;

- Language barriers made it difficult at some locations where international vessels were operating and some questions were initially misinterpreted;
- During site visits, it was only possible to verify the existence of certain documents, operational procedures, safety procedures etc since these documents are not always available in English and the exact contents could not be verified.
- There is a significant national and regional difference between the overall standards of the terminals included in this study.
- Subjecting terminals to external audits results in higher standards and lower risk priority levels.
- The site visits conducted were announced and planned well in advance.
- There was one terminal where the risk priorities were alarmingly high, posing a major threat to people, property and the environment.

The horizontal bar graphs, inserted at the beginning of the section for each member country, illustrate the division of risk priority areas per hazard group. They are the result of all the data of the risk assessments made by the National Working Groups, subsequently analysed and summarised into one graph. All the risk priority areas (1 to 4) of all hazards are included to provide a general overview (Figures 50 and 51).

3.4.5 Cambodia

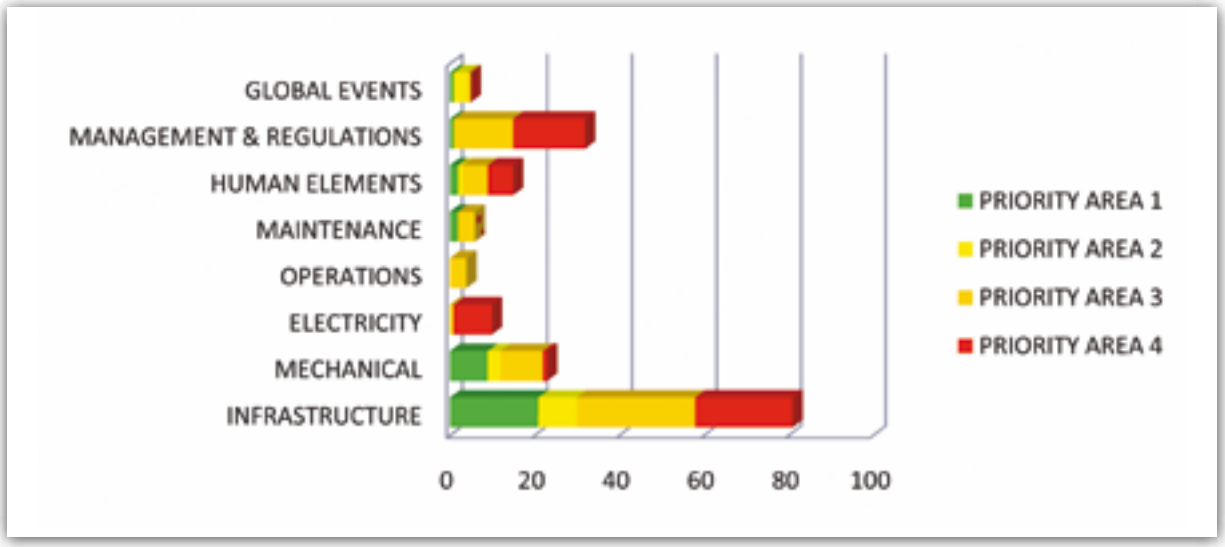

Figure 50: **Cambodia - Average Terminal**

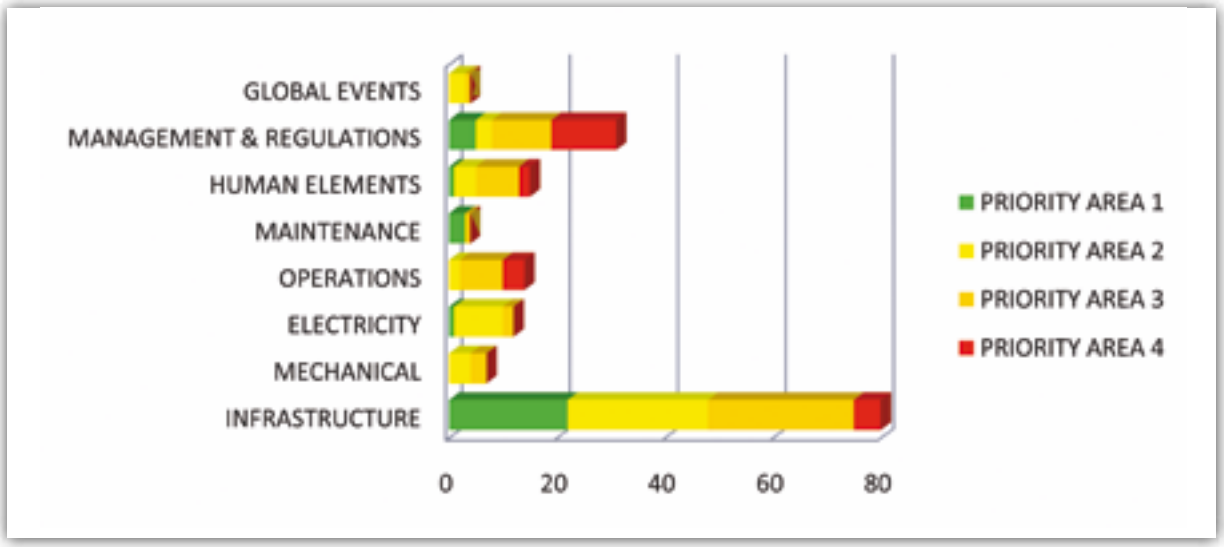

Figure 51: **Cambodia - Phnom Penh Port**

The graph illustrates the priority area per hazard group. We can conclude there are mainly four hazard groups with numerous high and very high priority areas: **infrastructure, electricity, human elements and management and regulations.** The major priority areas in all hazard groups are high to very high (Priority Areas 3 & 4). The absence of regulations, authority control and law enforcement have a risk Priority Area 4.

As already discussed earlier and as confirmed by the findings of the National Working Group in the risk register, there is currently no legislation on the transport, handling and storage of dangerous goods in Cambodia. The immediate consequence of having no fundamental legal framework is that:

- no laws, rules or regulations have been implemented;
- no authority control or enforcement is possible as the controlling authority has limited laws, rules or technical standards that can be used as a reference to undertake inspections; and
- no guidelines have been produced to assist private port and petroleum companies to manage health, safety and environmental issues.

There are many hazards from different hazard groups that have a higher priority due to the lack of a legal framework as illustrated in Table 31 below:

Table 31: **Example of Priority Areas Related to Legal Framework**

4701	All	No DG register	No knowledge of location/ quantity and nature of DG. Wrong response in case of emergency	3
4702	All	DG register not up to date		3
4703	All	MSDS not available	Properties of stored DG unknown: wrong response in case of emergency	3

If there was a legal requirement to keep a dangerous goods register and keep it up to date with the necessary Material Data Safety Sheets (MSDS) then the risk priority area of these items would certainly decrease.

In Cambodia, individual ports and terminals have to decide themselves about how they are going to

deal with certain hazards and the standards they are going to use for implementing control measure(s) to reduce the risk of these hazards to an acceptable level. Leaving this responsibility to individual ports or terminals potentially compromises the way they are going to deal with certain hazards or control measures to be implemented as they are often subject to commercial pressure. This can be determined if we look at the results of the risk register. Some terminals have, for example, made resource/time available for organising training of employees, drills and courses and inspection of equipment, oil spill equipment etc. Other terminals, often under commercial pressure, comply with minimum safety standards only, and have limited resources and time available for training terminal personnel, organising drills and courses and with breakdown maintenance performed instead of preventive or predictive maintenance. This, however, exposes not only terminal personnel but also adjacent communities and the environment to severe risks.

Having a fundamental legal framework alone, however, is not enough. Authorities must have the education and resources to verify if this legal framework is actually implemented and take appropriate action if non-compliance occurs. Penalties for violations should be severe enough to discourage violations. These inspections, if carried out at regular intervals combined with efficient law enforcement, will give the ports and terminals an incentive to comply with the legal framework.

3.4.5.1 Conclusions for the Terminals

- The combination of having a legal framework for the carriage, handling and storage of dangerous goods, sufficient measures to control the implementation of this framework and an efficient law enforcement system would reduce the average risk priority area of the risk register in Cambodia.
- A clear reporting and communication procedure has not been established to ensure that the competent authorities are notified in case of an accident/incident. Each accident must be considered as a learning opportunity. If properly analysed, lessons can be learned to prevent recurrence.
- Some terminals are located in densely populated areas and have trucks coming and going on/off the premises for loading/discharging dangerous goods. The impact of these trucks passing through densely populated areas being involved in a accident can affect many people and infrastructure.

Figure 52: **Terminal Located in a Densely-Populated Area**

- Not all terminals have emergency-shutdown systems so vessels are not able to initiate manually an emergency shutdown during loading/discharging dangerous goods.
- High-level alarms are not regularly tested or calibrated. When a tank containing flammable liquid overfills, fire or explosion are usually unavoidable. Any spark nearby may ignite flammable vapours released from the tank. The overall system for tank-filling control should be of high integrity with sufficient independence to insure timely and safe shutdown to prevent tank overflow. Periodic testing and maintenance of overfill-prevention systems will minimise the likelihood of any failure that could result in loss of containment.
- Flammable gas-detection equipment is not functioning or not calibrated. Fixed flammable gas detection equipment in the secondary containment is a measure to detect hazardous conditions arising from loss of primary containment. Portable gas-detection equipment is used to check the presence of flammable gas in confined spaces, before starting hot work, etc. Only one terminal had portable gas-detection equipment calibrated externally.
- It remains unclear if all terminals have sufficient emergency equipment and/or an emergency control centre. There are no requirements concerning oil-spill response or containment. Emergency equipment is used to minimise the consequence of an incident and is therefore vital for each terminal handling dangerous goods. Considering the location of certain terminals, there are no requirements about coordination between terminal and local authorities for evacuation plans for local communities.
- No hot-work permit system is in use. Maintenance/hot work is the second most frequent cause of storage-tank accidents. Therefore, hazard-reduction measures must include proper hot-work procedures such as obtaining a hot-work permit, this permit most cover having a fire watch and fire-extinguishing equipment present, proper testing for explosiveness, covering and sealing all drains, vents, man-ways, open flanges and sewers.
- Some terminals have no or limited maintenance system in place. Break down maintenance is performed instead of preventative & predictive maintenance.
- Some terminals have no colour-coding system for portable fire extinguishers which are sometimes found in a visibly bad condition and are often not readily accessible.

Figure 53: **Poorly Maintained Equipment**

Figure 54: **Fire Extinguishers in Poor Condition and Not Readily Accessible**

- Some cargo pipes and hoses are in bad condition, some cargo pipes are not properly supported and some hose ends not properly blinded. Furthermore, cargo hoses are apparently not regularly pressure tested. Hose assemblies should be regularly hydrostatically tested to check their integrity. Hoses for which the rated pressure has been exceeded must be removed from service and retested before further use.
- Some terminals do not comply with the ISPS Code. However, it must be noted that terminals that don't comply with the ISPS Code have reasonable security measures in place such as fences around the premises, guards at gates and CCTV.
- No checklists are available for critical operations. The purpose of a checklist is to detect a potential error before it leads to harm.

Figure 55: **Cargo Pipes and Hoses Not Properly Supported**

- There is a significant difference between safety management systems at terminals. Safety management systems cover the following basic elements: safety organisation, process safety information, operating procedures, training, work permits, mechanical integrity, maintenance, emergency planning and response, occupational health, incident investigation etc.

3.4.5.2 Conclusions for the Ports

- Dangerous goods are not segregated. The storage and handling of dangerous goods should be sufficiently isolated from other facilities to protect the dangerous goods from external hazards. Incompatible dangerous goods should be segregated to avoid chemical reaction, fire, explosion or the release of toxic vapours. Dangerous goods should be separated from ignition sources as far as practical.
- Cambodia has signed and ratified the SOLAS Convention. Although primarily aimed at vessel operators, the IMDG Code extends to everyone dealing with dangerous goods in the international transport and logistics network. Port and terminal operators and staff in particular have to be familiar with the provisions and requirements of the IMDG Code. With the adoption of Amendment 34-08 to the IMDG Code on 1 January 2010, the requirement that shore-based personnel involved in the handling of dangerous goods for sea transport be provided with appropriate training became mandatory for all countries. The mandatory training requirement has been adopted in recognition that the

Figure 56: **Container with IMDG Cargo at Phnom Penh Autonomous Port**

successful application of the requirements and objectives of the IMDG Code is dependent on those involved having an appreciation of the risks and a detailed understanding of the requirements. The pictures below illustrate containers stuffed with dangerous goods at Phnom Penh Autonomous Port.

- Although Cambodia has signed and ratified the SOLAS Convention, the Phnom Penh Autonomous Port does not yet fully comply with the ISPS Code. In 2006, Cambodia received official development assistance from Japan to help improve security facilities and surveillance in the port area and help establish a firm security structure to meet the mandatory request of the ISPS Code. The following was supplied:[42]
  - CCTV camera surveillance system;
  - ID pass card system; and
  - security station.

  The *Maritime Transportation Security Act* of 2002 (MTSA) has mandated that the United States Coast Guard evaluates the effectiveness of anti-terrorism measures in foreign ports and provides for the imposition of conditions of entry on vessels arriving to the United States from countries that do not maintain effective anti-terrorism measures (MTSA, 46 USC § 70108). Security efforts made by Phnom Penh Autonomous Port have been re-warded as the Coast Guard has determined that it is maintaining effective anti-terrorism measures[43] (Port Security Advisory [4/11]).

- Port cranes are used beyond rated capacity which means that limit safety devices are not working, not tested or not present.
- Firefighting equipment is either not available or not sufficient.
- Insufficient or no material, emergency equipment or spillage-control equipment is available to deal with an emergency and there are no emergency control centres.
- There is no management concerning dangerous goods and there are no operating procedures for receiving/delivering dry bulk or for storing/handling dangerous goods.
- The port has no dangerous goods register and some MSDS are not available.
- The port employees have not received special training on how to handle and store dangerous goods, emergency procedures or aquatic pollution prevention.
- Emergency response drills are not organised on a regular basis involving all port/terminal personnel. Emergency response drills are the best way to test emergency response plans and the effective response of the crisis team members. Additionally, they are an excellent way to improve emergency planning and communications.

3.4.5.3 Conclusions on Additional Activities and Operations

- During the risk assessment, the National Working Group observed several small vessels that supply fuel to communities living in Krakor. The vessels carry an average of 1,800 litres of petroleum products in plastic containers for local fuel supply. As these vessels operate on average eight months per year during the wet season, a significant amount of fuel is

[42] http://www.kh.emb-japan.go.jp/economic/oda/odalist_march2011-e.pdf

[43] https://homeport.uscg.mil/cgi-bin/st/portal/uscg_docs/MyCG/Editorial/20111014/PSA%204-11.pdf?id=b7984190f8b9f924b4a60db7570fe67d3bfb405c

transferred. The National Working Group expressed concern about these operations as they take place with no or very limited controls. For these operations, no safe operating procedures are required and the risk of operational errors resulting in fire/explosion or pollution is very high. These operations urgently need to be regulated or prohibited as the risk priority area is very high.

- In Chhong Kneas, the National Working Group observed that trucks supply fuel directly to barges (200 tonnes) during eight months of the high-water season. The fuel is then transported to fuel supply stations. About 15,000 tonnes are transferred per year. There are no berthing facilities and these operations are undertaken in close proximity to small passenger vessels and tourist boats. Since no safe operating procedures are required, the risk of operational errors resulting in fire/explosion or pollution is high. These operations urgently need to be regulated or prohibited as the risk priority area is high to very high and pollution has already been observed on the banks of the lake.

- During the high-water season, there are several fixed and floating fuel stations operating on the Tonle Sap Lake. With no safety operating procedures required, the fuel station operators have limited awareness of dangerous goods and the risks involved. These operations need to be urgently regulated or prohibited as the overall risk priority area is very high and the lake is considered an important wetland that is sensitive to water pollution.

Figure 57: **Fuel Transfer with a Very High Risk Priority**

3.4.6 Viet Nam

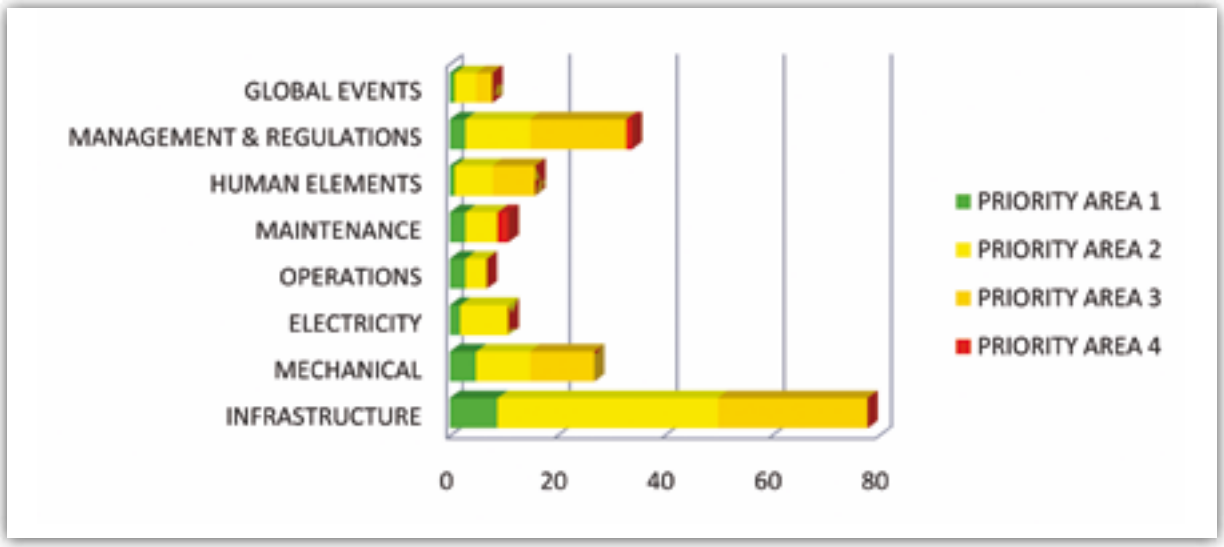

Figure 58: **Viet Nam - Terminals**

Figure 58 illustrates the priority area per hazard group. The hazard groups with the highest priority area are management and regulations, human elements mechanical and infrastructure. The absence of authority control and law enforcement has a risk Priority Area 3.

As already discussed, legislation concerning the transport, handling and storage of dangerous goods is a complex system of legal documents issued by different state agencies. Most aspects are covered by existing legislation and Vietnam Standards (TCVNs) regarding terminal construction and equipment. Several international standards such as ISO (International Organisation for Standardisation), IEC (International Electrotechnical Commission) and ASTM (American Society for Testing and Materials) have been adopted as TCVNs. However, the system of standards is complex and only about 40 percent of the national standards system has been developed by adopting relevant international and regional standards (e.g. ISO). The complexity of the legislative system and monitoring compliance by terminals handling petroleum products requires well-qualified inspectors who have thorough knowledge of the legislative system and standards.

According to figures provided by VIWA for the Mekong Delta in Viet Nam, there are two inland waterway port authorities (comparable with port state control) for the terminals. Port Authority 3 is responsible for 676 ports of which 137 are used for fuel transfer. Port Authority 4 is responsible for 1,426 ports of which 137 are used for fuel transfer. With 50 inspectors, Inspection Groups 5 and 8 are responsible for controlling the 2,102 ports under Port Authorities 3 & 4 as well as vessels and aids to navigation. Does the capacity for effective monitoring compliance of the terminals need to be strengthened, is there a lack of quantity and quality of personnel and are there sufficient funds?

The Government of Viet Nam recently issued *Decree No. 117/2009/ND-CP* which regulates penalties for environmental violations in an effort to raise the awareness of people and enterprises about the need for environmental protection. Companies which do not make environmental assessments are liable to fines of between VND 200 million ($9,500) and VND 300 million ($14,300). These fines are not

big enough to deter violators and Viet Nam intends to increase them. Minister of Home Affairs Nguyen Thai Binh has told the National Assembly that the draft Law on Administrative Fines will see increases across the spectrum up to a maximum of VND 2 billion ($100,000).[44]

During a National Assembly discussion about enforcement of pollution laws in Viet Nam in November, 2011, the following main points were noted:

- many legal documents are produced too slowly or were too general, making them difficult to enforce;
- authorities have not yet paid due attention to environmental protection while penalties for violators are low;
- environmental impact assessments receive little attention during investor licencing processes, despite being compulsory under the Law on Environmental Protection;
- there are enough legal documents but the problem is the low quality and the ineffective execution of these documents;
- many provinces turn a blind eye to violations because they want to attract investment and hence generate jobs and contribute to growth; and
- while the Law on Environmental Protection of 2005 relates to seven ministries and localities, coordination is neither smooth nor in accordance with their responsibilities and regular inspections are not yet being conducted.

The management of oil spills in the seaports of Viet Nam is well regulated. The National Committee for Search and Rescue (VINASARCOM) is the lead agency for oil spill response and is responsible for the implementation of national contingency plans. Viet Nam has three national oil spill response centres. The third, opened in October 2011, is equipped with a modern vessel equipped with the latest technology. The centre is able to cope with Tier II spills (100 to 2,000 tonnes). For inland waterways, however, there are no such provisions.

For the inland waterway ports/terminals, there is no regional oil spill management plan and there are no national provisions for oil spill equipment, nor a national oil spill response centre.

3.4.6.1 Conclusions for the Terminals

- Due to the presence of a legal framework and technical standards, the general standards of the terminals are good and there is more regional consistency between terminals. Observed differences mainly relate to the year of construction of the terminals.
- In general, cargo pipes, hoses and valves meet the relevant technical Vietnamese standards (TCVN). Pipes are properly supported and are provided with a colour-coding system. Cargo valves and pumps are maintained according to relevant Vietnamese technical standards.
- During the risk assessment, it was observed that cargo pipes not in use are only partly bolted. At most, only half of the bolts were in place and secured which could lead to a spill if pressure is applied (see Figure 60).

[44] http://www.cleanbiz.asia/story/vietnam-increase-environmental-fines

Figure 59: **Example of Cargo Pipes at a Typical Vietnamese Terminal**

- Most Vietnamese terminals (head office) already have ISO certificates. Others are expecting ISO accreditation in the near future.
- Naked lights on the decks of vessels are not immediately related to terminals but can influence general safety during cargo transfer (see Figure 61).

Figure 60: **Cargo Pipes Not In Use Not Fully Bolted**

Figure 61: **Naked Light Onboard Vessel Docked at Terminal**

- Safety devices are not working. Safety devices are intended to be used either manually or automatically when cargo transfer conditions are not as expected (safety relief valves open if pressure increases above the limit, emergency stop buttons provided in case of emergency, filling level becomes above limits, etc.). Failure of these devices can eventually lead to a spill.
- Valves, gasket seals or flange leaks can cause minor spills or extensive spills if not noticed and remedied in due time (see Figure 62).
- Emergency valves not readily accessible can lead to a delayed response in case of emergency.
- No international shore connection. In the event of fire and breakdown of the vessel's fire pump(s), the terminal cannot connect to the fire main on the vessel, leading to a delayed response and possibly an uncontrollable fire.

Figure 62: **Minor Spill Probably Due to Gasket/Flange Leak**

- Terminal fire protection falls under the responsibility of the Ministry of Public Security. According to the National Working Group, they receive specific training regarding terminal safety/firefighting equipment.
- If no waste reception facilities are available for vessels, all waste generated onboard will be dumped into the river or at other locations on land.
- Most of the terminals have an on-site emergency response plan and emergency equipment available. However, the National Working Group has indicated that in the equipment is not sufficient to respond in the event of a substantial emergency. There is no national emergency control centre.
- In Dong Thap, much fuel is supplied to local smaller terminals by means of trucks from the main terminal. The condition and hazards related to these trucks should be well monitored in the future.
- Use of explosion-proof equipment should be mandatory for vessels calling at fuel terminals.
- There is a need for additional training and awareness regarding the storage and handling of dangerous goods, environmental protection and waste management.
- The National Working Group indicated that privately-owned terminals and floating fuel stations, although not included in the risk assessment, are not aware of existing national regulations and technical standards. They have no or limited safety management and risk controls in place. This could not, however, be verified as these terminals are beyond the scope of this project.
- No waste management. The terminals have no waste-reception facilities available for waste from vessels. There is, however, the possibility of having a third party come and collect the waste. Oily water produced at terminals is mostly treated on site by an oily-water separator and then discharged into the river. There are no technical guidelines on oily waste collection and treatment. Government inspection and public awareness of oily waste management and treatment is insufficient. One of the sites visited had an oily water separator. Oily water was passed through the separator and then discharged straight into the river. The effluent that passed through the separator was inspected visually but not sampled nor measured for eventual remaining contamination.

3.4.6.2 Conclusions on Additional Activities and Operations

During a field trip along the Mekong, numerous fixed and floating pumping stations were observed. Some of these pumping stations are located in dense populated areas and can store quantities up to 15 m^3 (15,000 litres) of fuel. Fuel stations under state companies seem to be in good condition. However, the privately-owned ones have no or limited controls. Given the location of these pumping stations and the reasonable amount of fuel that is stored, they require further investigation. Such fuel stations have already been prohibited in Tien Giang province due to safety and environmental protection.

3.4.7 Regional Conclusions on Cambodia and Viet Nam

The overall quality standards of terminals in Viet Nam is better than in Cambodia. On a national level, the standards of the Vietnamese terminals are consistent mainly due to the existence of a legal framework and applicable technical standards. In Cambodia, however, there is no consistency in the quality standards of the terminals included in the risk assessment. This is mainly due to the lack of a legal framework. Notwithstanding the absence of the necessary legal framework, Cambodia has good quality standards at several private terminals.

As can be seen in the risk register, most ports and terminals in Cambodia and Viet Nam have no facilities to receive solid or liquid waste. Having proper waste reception facilities for vessels can be an incentive to dispose waste ashore rather than in the river. The disposal of all kinds of waste into the river has already reached alarming levels. In Viet Nam, however, it is possible to let third parties collect waste from vessels. Viet Nam has environmental laws regarding waste management but there are no technical guidelines on oily waste collection and treatment. Government inspection and public awareness of waste management and treatment is still insufficient.

Both Viet Nam and Cambodia have indicated the need for additional training regarding the carriage, handling and storage of dangerous goods. Awareness of the associated risks still needs still to be increased. Training should be provided for all employees involved in the process. Training needs mostly include but are not limited to:

- specific training on the storage and handling of dangerous goods;
- firefighting equipment and procedures;
- emergency response procedures;
- accident prevention;
- environmental protection; and
- waste management.

In Cambodia, emergency response plans and sufficient equipment is not always available or is too limited. In Viet Nam, the terminals have local on-site emergency plans and equipment available. But at the national level, there are no or limited provisions. Taking into account the trans-boundary consequences of a major pollution incident, there is no regional oil spill management plan for the Mekong.

Neither in Cambodia nor Viet Nam have statistics available on any accidents/incidents. In Cambodia there is no clear reporting procedure to ensure that Ministry of Public Works and Transport, the Ministry of Environment and local authorities are notified in case of an accident/incident. Although Viet Nam has a circular on reporting labour accidents, there is no evidence provided by the National Working Group that accidents such as oil spills and fires are reported accordingly to the competent authorities.

3.4.8 Thailand

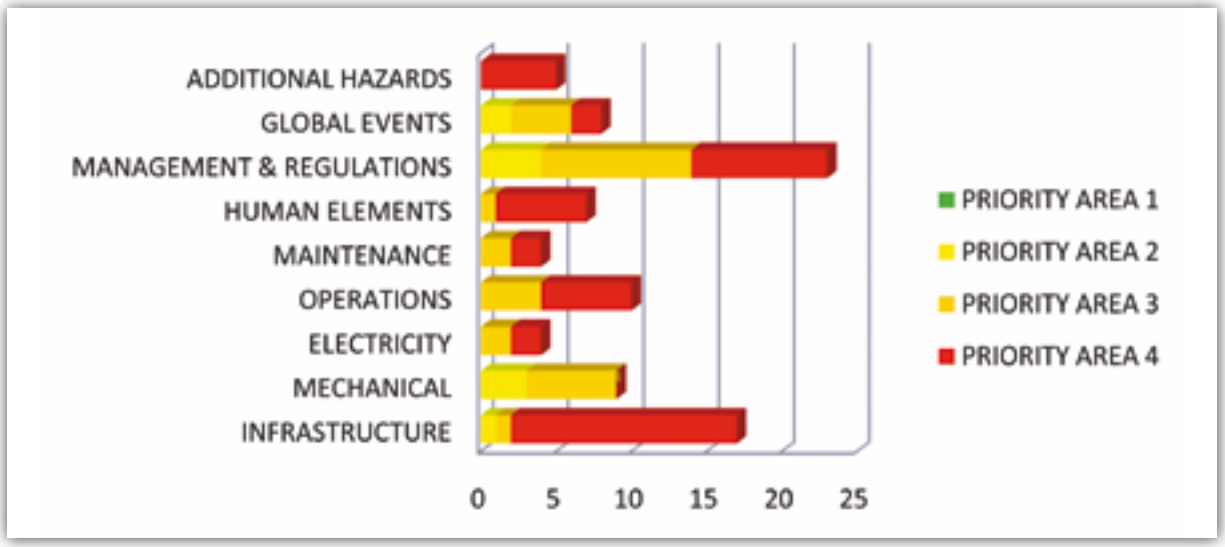

Figure 63: **Thailand - Ports**

Figure 63 illustrates the priority areas per hazard group. Almost all hazard groups contain several items with a very high priority area. The National Working Groups have indicated that there is a clear and urgent need for action to reduce the risks.

The legal framework concerning transport and handling of dangerous goods covers almost all aspect and is relatively clear. Compliance with rules and regulations is enforced by means of penalties such as fines, imprisonment or license withdrawal. The Port Authority of Thailand (PAT) is familiar with Port Safety and Health and Environmental Management Systems (PSHE-MS) as proven by the recognition certificates for dangerous goods service obtained by Bangkok Port and Leam Chabang Port. The PAT has developed port waste management systems for several international Thai ports. These efforts should be continued and encouraged.

Standards for international maritime ports need to be applied to inland ports on the Mekong River. As can be concluded from the risk assessment made by the National Working Group, the regional ports have a clear need for the development of similar systems (PSHE-MS, port waste management etc). The construction of Chiang Saen Port II, seen as a major gateway between Thailand and southern China, is expected to be completed in 2012. This would be an excellent opportunity and starting point to extend the PAT efforts already made for the international ports to the regional ports.

Additionally, the National Working Group noticed some local fuel-transfer operations that pose a considerable risk to the environment and safety of people. These local fuel supplies are not regulated by the authorities and are carried out with unsuitable materials (drums and hoses in bad condition). There is no equipment available to contain spills, no safety procedures available, no emergency equipment available etc. These local fuel supplies are small-scale activities but need to be controlled.

There are numerous ferry crossings transporting considerable amounts of dangerous goods (tank trucks, packaged dangerous goods on trucks) between Thailand and Lao PDR. According to the risk assessment by the National Working Group, there is an urgent need for regulating these ferry crossings.

3.4.8.1 Conclusions

- At some ports and ferry crossings, there is no fixed or portable firefighting equipment available. If limited portable firefighting equipment is available, it is not regularly tested/inspected. Ports or ferry terminals depend on firefighting equipment onboard the vessels/ferries.
- Some ports have no designated area for the storage of dangerous goods. No proper containers are used to store dangerous goods and these containers are not properly labelled. There is no register of dangerous goods available.
- No procedures are available for the transfer of fuel from trucks to barges.

Figure 64: **Fuel Transfer from Truck to Barge**

- No waste reception facilities are available for ferries or at local fuel transfer sites. Waste generated by trucks and port operations is not collected.
- No measures are in place to deal with spillage of dangerous goods (emergency response plans) and equipment available is not adequate to contain spills.
- No correct PPE is provided and there is no lifesaving equipment available at ferry sites.
- No emergency/lifesaving response drills are conducted.
- There is a lack of training on handling dangerous goods, emergency/firefighting equipment, safe navigation, ferry operations, accident prevention, environmental protection or waste management.
- There are no procedures for ferry-crossing operations, communications between port and ferry, safety procedures, inspection of trucks before boarding ferry, loading/unloading dangerous goods, hot works carried out in port or on the ferries or reporting of accidents/hazards (there are no records of accidents/hazards).

- No checklists available for loading/unloading ferries, maintenance of the port/ferry, safe navigation, ferry operations and inspection of trucks.
- New staff not properly familiarised/trained, operators not aware of national regulations.
- Some terminal and port equipment are in poor condition, not regularly inspected and maintained. No maintenance records are available and no maintenance system in place.
- The access to the port uncontrolled, no surrounding wall, no fence and no controlled gate. No procedures are in place to prevent uncontrolled access.
- No VHF radios available for communication. There is no communication between the port and the ferries and no communication between left and right bank.

3.4.9 Lao PDR

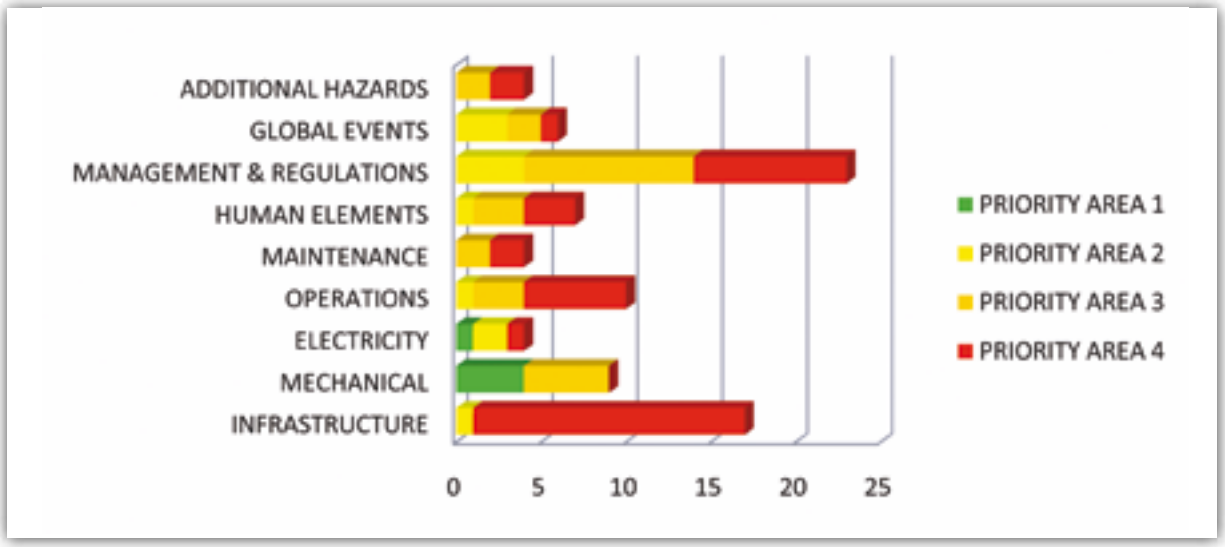

Figure 65: **Lao PDR - Ports**

Figure 65 illustrates the priority area per hazard group. Almost all hazard groups contain several items with a very high priority area. The National Working Group indicated that there is a clear and urgent need for action in order to reduce the risks.

No dangerous goods are currently handled and stored at Km 4 State Port.

As all national laws, rules and regulations, and decrees that apply to inland waterway ports and terminals are in Lao, the exact content of these documents could not be established.

The Waterways Department does not evaluate or monitor compliance with environmental laws. The Water Resources and Environment Authority (WREA) is responsible for implementing and enforcing environmental laws in Lao PDR. There should be more communication between the Waterways Department and WREA to ensure that environmental laws are applied to port and vessel operations.

The MPWT and the Waterway Department has very limited capacity to respond to emergency situations or to investigate incidents properly. Lao PDR requires urgent investment in emergency response.

There are 29 Lao ports along the Mekong River. Most are quite small and used to transport goods for domestic use. The ferry crossings are used to transport tank trucks, asphalt, fertiliser and other dangerous goods from Thailand to Lao PDR.

Figure 66: **Mekong River Ports in Lao PDR and Thailand**[45]

[45] The existing Chiang Saen Port is scheduled to become a passenger terminal after Chiang Saen Port II opens in 2012. The new port is located about 10 km downstream from the existing port at the confluence of a tributary and the Mekong River.

3.4.9.1 Conclusions

- At Km 4 State Port and some ferry crossings, there is no fixed or portable firefighting equipment available. If (limited) portable firefighting equipment is available the equipment is not regularly tested/inspected. The port or ferry terminal depends on the firefighting equipment onboard the vessels/ferries.

Figure 67: **Poor Maintenance of Port Equipment**

- Km 4 State Port and the ferry crossings have no designated area for the storage of dangerous goods. No proper containers are used to store dangerous goods and these containers are not properly labelled. There is no register of dangerous goods available.
- No waste reception facilities are available for the port / ferries or local fuel transfer sites. Waste generated by trucks and port operations is not collected.
- No measures are in place to deal with spillage of dangerous goods (emergency response plan) and equipment available to contain spills is not adequate.
- No correct PPE is provided and no lifesaving equipment is available at the ferry site.
- No emergency/lifesaving response drills are conducted.
- There is a lack of training on the handling of dangerous goods, emergency/firefighting equipment, safe navigation, ferry operations, accident prevention, environmental protection and waste management.

- There are no procedures for ferry-crossing operations, communications between ports and ferries, safety procedures, inspection of trucks before boarding ferries, loading/unloading dangerous goods, hot works carried out in port or on the ferries or reporting of accidents/hazards (there are no records of accidents/hazards).
- No checklists are available for loading/unloading ferries, maintenance of the port/ferry, safe navigation, ferry operations or trucks inspections.
- New staff are not properly familiarised/trained, and operators are not aware of national regulations.
- Some terminals and port equipment are in poor condition, and not regularly inspected or maintained. No maintenance records are available and no maintenance systems are in place (see Figures 67, 68 and 69).

Figure 68: **Poor Maintenance of Port equipment**

Figure 69: **Power Supply Arrangements for Fuel Pump**

- Access to port is uncontrolled, with no surrounding walls or fences or gate. No procedures are in place to prevent uncontrolled access.
- No VHF radios are available for communication. There is no communications between ports and ferries and no communications between the left and right banks.

General Conclusions

The general awareness of the risks associated with the carriage, handling and storage of dangerous goods and the consequences these can have on the environment, people and property are not always well understood and needs to be improved. All parties involved in the process should be well aware of all possible hazards and their eventual consequences. Such involvement should not be limited to the management level but all personnel.

Some hazards identified can, although not always, be eliminated at almost no cost just by exercising good management practice. Figure 70 illustrates an example of pollution that can be eliminated at almost no cost.

3.4.10 Regional Oil Spill Prevention and Response

The adverse effects of oil spills on the natural environment are widely recognised among the riparian countries and immediately apparent as they are visible. But the sustained release of smaller - often visually undetectable - amounts of oil in wastewater from terminals can be just as damaging.

Figure 70: **Small fuel spill in port area**

On the 12 January 2006, ministers, senior government officials and various other stakeholders from Cambodia, Thailand and Viet Nam gathered in Hanoi and issued a joint statement on partnership in Oil Spill Preparedness and Response Cooperation (OPRC) in the Gulf of Thailand. The joint statement contains a tripartite inter-governmental agreement which commits participating countries to mutual support and assistance in combating oil spills in the gulf region. The joint statement endorses a framework programme for joint oil spill preparedness and response in the region, specifying obligations and responsibilities of participating countries as well as a coordinating mechanism and arrangements for implementing the framework programme. The joint statement and framework programme are regarded by the participating countries as an important legal basis for multilateral cooperation in oil spill preparedness and response in the Gulf of Thailand[46]. This agreement shows clearly that trans-boundary oil spill management is possible between the riparian countries. However, a similar programme for the Mekong River has not yet been developed.

All ports and terminals of the riparian countries seem to struggle with problems regarding waste management. Most ports/terminals have no provisions to accept waste from vessels. However, all riparian countries seem to have some environmental laws in place regarding waste management. At the same time, there are no technical guidelines on oily or solid waste from vessels and terminals. Government inspection and public awareness of waste management and treatment is insufficient.

Although the riparian countries find themselves in different stages of development with varying levels of wealth, population, literacy and access to clean water and sanitation, many share the same problems regarding the risks associated with the carriage, handling and storage of dangerous goods. Solving these problems can only be achieved though good cooperation and efficient exchange of information between governments and the private sector. This is an excellent opportunity to collaborate and share information so that the risks and consequences involved can be reduced in a economically feasible way to an acceptable level for all concerned.

[46] http://www.pemsea.org/sites/addressing-transboundary-concerns-in-pollution-hotspots-gulf-of-thailand


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